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STATUS OF BIOLOGY IN THE SECONDARY SCHOOLS OF OREGON.

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This report is a summary of the results obtained from a questionnaire sent out by the class in the teaching of biology at the University of Oregon during the winter session, 1925. Questionnaires were sent to approximately two hundred schools, of which one hundred and seven responded. The enrollment of these ranged from six to twelve hundred and seventeen, with fifty-eight as the median. In order to insure frankness in replies, the names of the schools were not required, so we had no way of determining just how far our results were representative. Yet our variation in enrollments compared with the variation in the total secondary enrollments for the state, indicated that we had every size of school in about the normal proportion. A composite enrollment of 9889 students is included in our report. Of this number, 26.6% were estimated to be receiving biological training at some time during their high school course. One is led to inquire why this number was so low? Three answers suggest themselves—first, that courses in biology were not available for the students; or, second, that sufficient emphasis had not been placed upon its importance; or third, that it had been taught by poorly prepared, inefficient teachers who had not had a vision of the significance of biology in the life of the individual.

General Science was offered, usually in the freshman year, in 78.5% of these schools and followed by biology, botany, zoology, or physiology in most of them. Only 7.4% of the schools reported that no biological science was offered and some of these implied that it was given in alternate years. The preferences among the biological sciences were divided as follows:

Biology	62.6% of the schools
Physiology	45.8% of the schools
Botany	43.9% of the schools
Zoology	5.6% of the schools

The overlapping is due to the fact that more than one was given in the same school. With only a few exceptions the biology course required two semesters while the others were one semester courses.

The second year of high school work seemed to be the prevailing choice for the biological courses as indicated by the following scores:

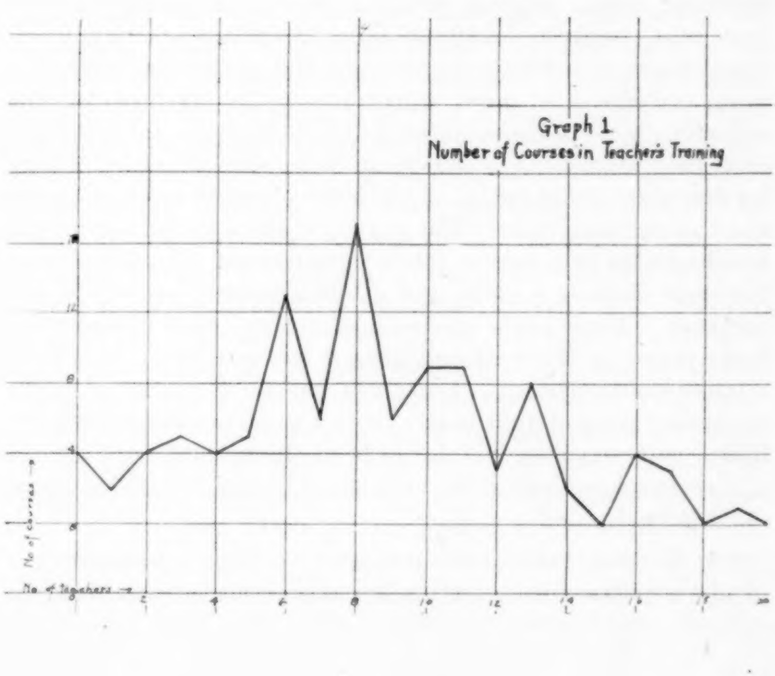
	Biology	Botany	Zoology	Physiology
9th grade	11	6	0	9
10th grade	44	36	3	37
11th grade	22	9	0	11
12th grade	17	4	0	5

In many schools the biology course was open to all high school students and not restricted to any one year. These results do not indicate that the deficiency in enrollment in biology was due to its absence from the course of study.

We do not have evidence to bear upon the emphasis which had been placed upon biology in the high school curriculum and all we can determine is by inference. A study of the teacher's preparation shows a number of interesting things. Six teachers reported that they have had no college training. They were teaching in smaller schools and were evidently older teachers holding life diplomas. As over against this there were eighteen who had had special training beyond their college work—post-graduate work, medical training, training and experience as technicians and in government work. Two held masters degrees. The universities and colleges were represented as follows —University of Oregon 26, Oregon Agricultural College 23, University of Washington 17, Williamette University 15, Washington State College 6, Reed College and Pacific University 5 each, Universities of Idaho, Minnesota, Nebraska, and Linfield College 3 each, University of California and Whitman College 2 each, and one from each of the following: Iowa Wesleyan, College of Puget Sound, Iowa State, Ottawa University, Universities of Colorado, Southern California, North Dakota, Indiana, Illinois, Philomath College, Pomona College, and Wm. Penn University.

The courses the teachers have taken is of far greater signifi-

cance. They range as follows:—Botany, 87; Physics, 80; Zoology, 74; Inorganic Chemistry, 70; General Physiology, 57; Human Physiology, 55; Agriculture, 55; Evolution, 46; Sanitation, 43; Bacteriology, 42; Organic Chemistry, 42; Geology, 41; Human Anatomy, 39; Plant Physiology, 38; Genetics, 21; Embryology, 19; Comparative Anatomy, 18; Paleontology, 10; Protozoology, 9; Cytology, 5. Courses in eugenics, entomology, neurology, ornithology, plant breeding, and plant pathology were also mentioned but were not on the questionnaire list. The large number who had checked general physiology caused a question to arise as to the interpretation which had been given by the teachers. General physiology courses as such are so new in the curricula of our colleges that this result is questionable and it may be that courses in human physiology have been listed here. In that case the number who had taken courses in human physiology would be increased placing it in the upper part of the list, as would be expected. It will be noted that the list breaks into three groups with botany, zoology, physics and inorganic chemistry in the first group. The range of the number of courses taken by each teacher varied from none to nineteen with an average of 8.4 per teacher. This is shown on Graph 1.

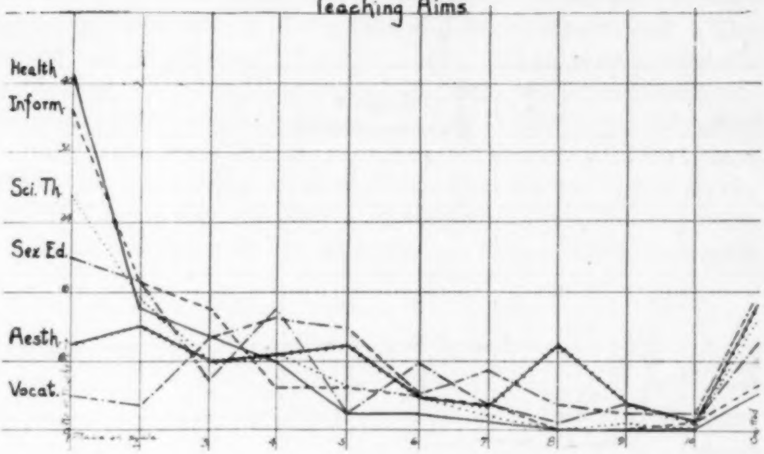


This does not indicate a deficiency in the training of the biology teachers. If, as suspected, human physiology belonged in the upper group the breadth of training was excellent and as much as could be expected with a fifty-eight pupil school as the median for the group under consideration. Of course this shows nothing of the content of the courses which the teachers had taken nor does it give a clue as to the attitude of those teachers toward their subject. The only evidence of that which we can get is in regard to the type of courses they were giving, the aims they chose and the methods they adopted.

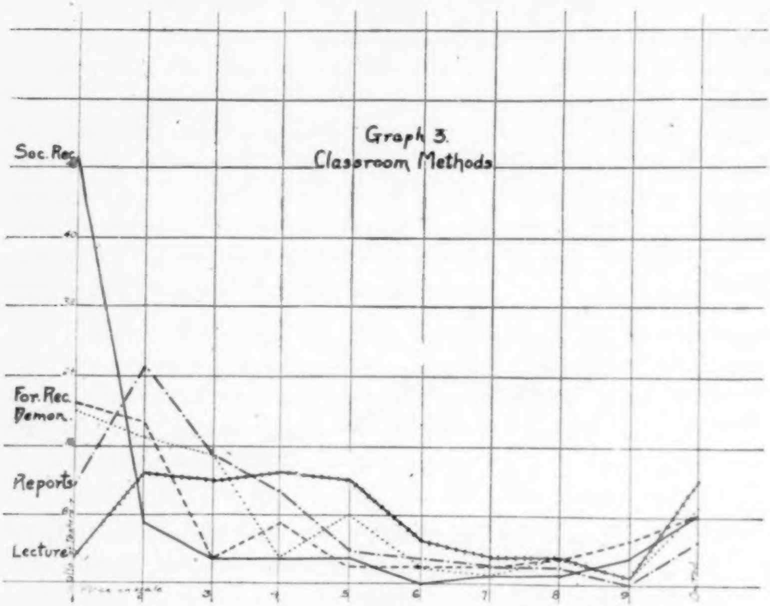
A number of possible aims for a course in biology were listed and the teachers were requested to number these in the orders of their importance using the same number for those of equal importance. In scoring these results ten points were allowed for a number one, nine for a number two, etc. The scores were as follows: Health instruction, 706; informational, 683; training in scientific thinking, 592; moral training, 581; sex education, 573; preparation for later work (as medicine, etc.), 548; cultural training, 440; vocational training, 430; aesthetic appreciation, 419; high school science requirement, 394. It may be noted that they break into three groups. Health and informational are considered the most important aims by the majority; scientific thinking, moral training, sex education, and preparation for later work, form the middle group; and cultural training, vocational training, aesthetic appreciation and to satisfy requirement were considered of least importance. The ratings for the different places is also of interest. This is shown for six of the aims on Graph 2. The curve for those aims which rank high for first place, falls rapidly on the other places showing an agreement as to their value. The curve for those ranked first by a small number of teachers, tends to run about even throughout the scale showing a great deal of disagreement as to their importance. Those rarely ranked first received more votes for the lower places on the scale indicating a fair agreement as to their relative unimportance. Little can be said in criticism of the resultant rating of aims unless there was an overemphasis upon health and encyclopedic information. Individual cases showed a narrow conception of the breadth of biology but the number of these was limited.

The methods used for the attainment of the aims varied quite as much as the aims. Only a few schools used other than the

Graph 2
Teaching Aims



State text. Hunter's Civic Biology was used almost universally for biology. Gruenberg was used in three schools, Smallwood in two, Needham in one, and Hegner in one. Bergen and Caldwell was used for botany with only one exception where Linville and Kelly was chosen. Hunter's Civic Biology, Hegner, and Pearce were listed for the zoology courses. With one exception (Colton and Murbach), Conn and Budington was the text for physiology. Thirty-one reported that they used the text for recitation while seventeen said they used it as a reference. Twenty-five teachers used it both for recitation and for reference depending upon the character of the work in hand. Classroom methods were scored as follows:—Socialized recitation, 558; reports by students, 512; demonstrations, 497; formal recitation, 474; lecture, 416; written quiz, 401; stereoptican and moving pictures, 347; current literature reports, 316; talks by outside speakers, 310. It is significant to note that socialized methods as Socialized recitation and Reports by students, headed the list, that the older methods of Formal recitation, Lecture, and Quiz took the intermediate position, and that the use of the Stereoptican and moving pictures, Current literature reports and Outside speakers were the least favored. The rating for places shown on Graph 3 indicates much the same points as the graph of the aims. Socialized recitation was far in the lead for first place then the curve falls rapidly, Reports were favored for second place, while many of the others which ranked very low on first choice show a rise on the curve for the



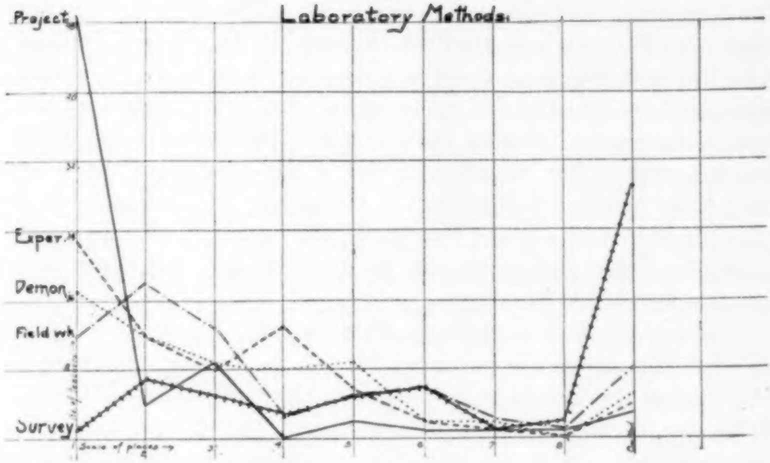
lower places indicating that they have a value in their place. It is also interesting to note that Formal recitation ranked second for first place showing a distinct contrast of viewpoints on the part of two groups of teachers.

Only four schools reported no laboratory with their biological courses. The reports on the time devoted to laboratory work were so indefinite that it is impossible to draw conclusions. The amount of time varied from one to four hours a week. One school reported six hours of laboratory a week and another nine but it is suspected that they called "periods" hours. Two hours a week was the amount of time devoted to laboratory work in most cases. The periods varied in length from twenty minutes to two hours with an hour and a half as the more common. Teachers in fifty-nine schools gave written or oral directions immediately preceding the laboratory work, forty-two used manuals, seven a syllabus, and three gave no directions to the students. With one exception a notebook was required and very emphatically so in some cases. This exception reported that a notebook was required at certain times depending upon the character of the work. The rating of laboratory methods showed much the same tendencies as the choice in classroom methods. Projects, experiments, demonstrations by instructor or students, and field work, headed the list; the older

methods, study of types and dissection, held the intermediate place; and community campaigns and surveys came last. The rating was as follows:—Projects, individual or group, 488; experiments, 413; demonstrations, 360; field work (including excursions), 356; directed study of types, 305; dissection, 267; community campaigns, 182; surveys, 144. The rating for first place shows the same order as that of the final scores. Field work, study of types and dissection tend to rise on the lower places, again indicating a value in their place. This is shown on Graph 4.

Graph 4

Laboratory Methods.



As a general thing laboratory work and class work were correlated. Two schools reported no correlation and two only partial correlation.

The majority of schools seemed to have no library budget. Some said that the biology department might have all the books it wished, or any within reason. Of those having an apportionment, seventy-five percent received less than ten percent of the school library funds. A few got as high as twenty percent. About twenty percent of the schools allowed no money for biology books. This is distinctly one weak point.

On the whole we would say that the outlook for biology in the secondary schools of Oregon is encouraging. It seems to be in a transition state. Many members of the old school who have not caught the vitality of the new biology are still hanging on. On the other hand many of the teachers indicated that they had an inkling of the possibilities and through these

teachers there is hope. Then we have the group to whom biology means a study of life in its biggest, best and broadest sense. From their instruction will come the students who will become the teachers of the future. We might acknowledge that the training of the teacher has been adequate and that the small enrollment in biology in our schools has been due to the fact that it has been crowded out by other subjects. But the boomerang comes back. If biology had been taught with inspiration which showed it to be a vital factor in the life of the teacher, it would have secured and maintained its position. Hence we say that the present status of biology in Oregon is what it is because of the teacher. It holds its position as a distinctly important course in the school curriculum because the teachers of biology have made it that important and its place is no more important because they have made it no more vital. In large measure this is due to the training these teachers have received in their college work. The criticism is one of the quality of the work they have received rather than of the quantity. Hence we conclude that if we want the biology of the future to offer to every individual what it intrinsically has to offer, we must begin with the training of the teachers.

Acknowledgment is made to Miss Dorothy Dixon, Mr. Thos. Holder, Mr. Louis Carlson, and Mr. D. A. French, members of the class in the Teaching of Biology at the University of Oregon, 1925, for their assistance in organizing and distributing this questionnaire. Also the splendid cooperation of the teachers of the state in supplying the needed information was greatly appreciated.

HEALTH OF THE SCHOOL TEACHER.

Absence of teachers from school on account of sickness, as compared with records of industrial workers and clerical groups, seems to indicate the superior health of teachers. Contrary to general belief, statistics show that the teacher is not more subject to diseases of the respiratory organs than other indoor workers, nor to diseases of the digestive organs. In regard to nervous diseases, however, and especially neurasthenia, or nervous exhaustion, records are not so favorable to the teacher, according to a study of the health of the teacher, made by Dr. James F. Rogers, chief, division of physical education and school hygiene, published by the Interior Department, Bureau of Education, in School Health Studies No. 12. Among teachers of New York City, neurasthenia is found to increase with age up to 45-54 years. In London, England, and in Victoria, Australia, the percentage of teachers suffering from this disease increased threefold from the time of entering service until the age of 50 was reached. The average number of days lost by London teachers increased three times during these years, the increase being most marked among single women. The only other disease in which there was a marked increase was rheumatism.

A REPORT OF ONE TECHNIQUE OF INDIVIDUALIZED INSTRUCTION IN NINTH-YEAR ALGEBRA.[1]

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I. The Problem.

It is almost universally recognized that individual pupils differ in their native capacity and in their general achievement at any particular age or school grade, and that the traditional school organization fails to make adequate adaptations to these differences. As a consequence, a great many people are giving increased attention to the problem of adapting schools to these differences. The general trend is to cease neglecting the individual and focus direct attention upon his powers and weaknesses. We find a tendency leaning in that direction in a variety of forms, namely; individualized instruction of such types as the Winnetka Technique, the Dalton Plan, the Batavia Plan, and supervised study of one form or another. The writer, being in a position to observe the procedure employed under the Winnetka Technique, wished to see whether or not it could be adapted to the secondary school situation, and specifically to see whether or not it could be adapted to the teaching of algebra. As a consequence, an experiment was started in February, 1924, and a technique was worked out which embodied basically the fundamental principles of the Winnetka Technique[2] and also some of the principles of the unit type of supervised study in operation now in the University of Chicago Laboratory Schools.[3]

II. The Experiment.

The situation under discussion deals with pupils who were in the first course of algebra (ninth year) of the regular four-year high school. While the experiment was in progress the writer was working with his own classes. There were two groups each year, a slow and a normal group. The pupils fell into their respective classifications according to ratings which were made from the results of a prognostic intelligence test (The Otis Classification) and the combined judgments of their teachers in the

[1]This article is the report of an experiment which was conducted by the writer while a teacher of mathematics in the New Trier Township High School, Winnetka, Illinois. The experiment was carried on through a period of two and one-half years and this article attempts to give the procedure and some of the general results of the last two years. The reader will note that this school is a separate and distinct organization from that which is supervised by Mr. C. W. Washburne.

[2]Washburne, C. W. Adapting the Schools to Individual Differences. Twenty-fourth Yearbook, National Society for the Study of Education.

[3]Breslich, E. R. The Unitary Organization of the Mathematics of the Seventh, Eighth, and Ninth Grades. Mathematics Teacher, 14:228-235, April, 1923.

elementary schools. The preliminary training which they had received was similar to that found in most elementary schools where the full program of the junior high school had not been put into effect. Other things being equal, the situation seemed to be one where such an experiment would have a fair chance to prove its worth.

Now, for any technique in individualized instruction to be effective it would seem that adaptable materials should become the first prerequisite. In this instance the materials were worked out covering the entire course. These materials are of the mimeographed experimental booklet type. The course is divided into twelve units and these are subdivided into smaller units called goals. Each goal contains adequate descriptive and explanatory material to prepare the pupil fully to understand the piece of learning for which the goal is defined. It also contains some real teaching and testing materials that deal directly with the material which the pupil is going to be required to assimilate. This teaching and testing is of two types: the solution and the complete explanation of several examples typical of those found in the assimilative material, and the partial solution of several more with directions for completion. This latter phase serves as a check on the pupil's understanding of the methods and facts needed to master the material within the goal. It is self-corrective.

Immediately following the preliminary materials of the goal we have the practice materials. This part of the goal is made up of exercises, twenty-five in number usually, and so arranged in cycles of four that any weakness may be definitely located. Also, there are six forms of a diagnostic test which accompany the other practice materials of the goal. All practice materials are self-corrective.

Then, as a check on the pupil's attainment of all the goals of the larger unit, we have the process of mastery testing. These tests cover the phases of the subject as they are taught in the goals. They are administered and corrected by the teacher. They are not in published form but it seems advisable to present a few as types of the three forms which have been constructed to cover each of the twelve units.

The tests are:

1. Which is the greater length, 100 meters or 110 yards?
2. What error is likely to be made in measuring 100 yards with an old yard-stick? Is it likely to be exact, too small, or too great?

3. State three ways of reading line-segments.
4. How would you measure 2.8 inches on cm-paper?
5. Represent a segment 41 inches in length by $3a$-$4b$. What is the length represented by a if b is 8 inches?

UNIT II. FORMULAS.

1. Which formula represents the perimeter of a triangle whose sides are all equal; $p = 2s+2b$, $p = 2s+\frac{1}{2}b$, $p = \frac{1}{2}ab$, $p = 3s$?
2. Find the value of i when $p = \$750.75$, $r = 5\frac{1}{2}\%$, and $t = 4$ years 6 months.
3. What will it cost Mrs. Jones to send her son's laundry to him if the parcel weighs 21 pounds and the destination is in the 5th zone? $(c = 6w-2)$
4. Upon what does the value of A depend in the formula $A = r^2$? Find A when $r = 3$ inches.
5. Henry has a marbles. How many has John if he has b more than Henry? $a-2b$ more?
6. Write a word statement to express the formula $p = 21+2w$.
7. What is the value of the formula $A = r^2h$, when $r = 2.4$, and $h = 3.6$?
8. What is the perimeter of a rectangle whose dimensions are m and n? What is the area?

UNIT III. GRAPHING.

1. Prepare a table to show the following data. Mary's attendance at school for one year: Sept. 20 days, Oct. 22 days, Nov. 19 days, Dec. 15 days, Jan. 19 days, Feb. 20 days, Mar. 22 days, Apr. 21 days, May 22 days, June 17 days.
2. Draw a bar graph to represent the data found in Ex. 1.
3. Make a graph showing the cost of any number of pounds of sugar up. 25 pounds when sugar is retailing at 8 cents per pound.
4. Represent the following data with a curved line graph: Hourly temperatures on Sept. 23, from 6 a. m. on are 68, 69, 71, 73, 73, 76, 79, 80, 78, 75, 74, 72.
5. Make a line graph to represent the cost of sending parcels by mail into the fifth zone. $(c = 6w+2.)$

The procedure which was followed throughout the experiment allowed the pupil to proceed at his own normal rate of learning. He attacked one of the small definite units, assimilation being effected through the abundance of practice materials. Of course he must thoroughly master the preliminary explanatory materials first. This is determined from the results of his efforts to complete the list of partially solved examples. If he failed to complete these satisfactorily he presented himself to the teacher for a representation which could really be adapted to his weaknesses; the teacher being aided by the incorrect performance. Now, the pupil having in his possession the needed tools, he turns directly to the practice materials. He attempts to solve a set of exercises consisting of one from each cycle. It is necessary to do this because the different cycles are made up of exercises of different degrees of difficulty. If he fails in his first attempt he selects another set and proceeds as before. All practice materials being self-corrective, the pupil can determine for himself whether or not he has a specific weakness. If he finds that he

has and cannot correct it himself, of course it is the duty of the teacher to reteach the items wherein the difficulty lies. When such a set has been completely mastered the pupil takes a practice test (one of the six forms) which accompanies the materials of the unit. On this test the pupil must show complete mastery. If he does not, the pupil being the judge, more practice must be done on the assimilative materials and other forms of the test taken, until mastery is attained. When a test shows mastery the pupil proceeds to the next small unit or goal and so on until all the subdivisions of the larger unit are mastered. He then presents himself to the teacher who administers the real or mastery test of the larger unit. Promotion or progress depends exclusively upon success in this test and mastery must be shown or the reteaching and re-testing program must be employed. In this manner the pupil progresses through the entire course.

III. The Results.

In obtaining data from which a fair estimate of the results may be obtained, only two specific sources were available. The first year's data are found in Tables I and II. It is to be noted that we have the results of one of the Hotz Scales which was administered to the two groups under discussion and to two other groups who are comparable as far as the grouping and the ground covered are concerned. This scale was administered because we have a recommendation from the National Committee[4] that if a single test is to be given, the Hotz Formula and Equation Scale is probably the best for measuring attainment.

For the second it is to be noted from Tables III, IV, and V, that our data concern the measurement of attainment through the results obtained by administering both the Hotz Scales and the Douglass Diagnostic Tests. Also, there are some data to be reported with respect to the time it took the respective groups to complete the course. It must be kept in mind that the members of each group were required to show the same degree of attainment when measured by the real or mastery tests. On the one hand the pupils of the normal group, with the exception of two, completed the course in 8 months (2 required only 7 months), and on the other hand there were three of the so-called slow group who had not finished at the end of the same period (1 completing course in 7½ months). The majority of both groups completed the work at approximately the same time, the range covering a period of fifteen days.

TABLE I. SCORES MADE BY TWO DIFFERENT GROUPS ON THE HOTZ EQUATION AND FORMULA SCALE, SERIES A (INDIVIDUALIZED INSTRUCTION 7½ MO.)

Averages	Pupils	
	Slow (23)	Normal (25)
Median	7.3	8.7
Tentative Standard	7.8	

TABLE II. SCORES MADE BY TWO DIFFERENT GROUPS ON THE HOTZ EQUATION AND FORMULA SCALE, SERIES A (GROUP INSTRUCTION, 9 MO.)

Averages	Pupils	
	Slow (26)	Normal (138)
Median	6.1	8.7
Tentative Standard	7.8	

In attempting to interpret these data, let us turn first to Tables I and II, since they deal with the results of the first half of the experiment. It is to be noted in Table I that the median score of the normal group (8.7) is considerably above the tentative standard (7.8) for the scale. In comparing Tables I and II we find that median scores of the normal groups of both types of instruction are exactly equal. Now what is the significance of this? First, are we not safe in concluding that these pupils under individualized instruction have a higher degree of achievement as measured by this scale than those thousands who were responsible for the standardization of the scale? Also, it must be borne in mind that the former results were obtained at the end of seven and one-half months of instruction whereas the standard is for nine months. This item supports our conclusion. Second, it would appear that the two groups of normal pupils whose achievements are represented by the median score of 8.7 respectively, are on a par. That may be true indeed. But again, when we take into consideration the time spent by each group in achieving the same standard, can we not claim that, other things being equal, the group which has attained a certain standard in seven and one-half months has done quite a great deal better than another group that attained the same standard in nine months? Then, if time is saved when a comparison is made with another group under group instruction, and the achievement is better and time is saved also when a comparison is made with the

TABLE III. SCORES MADE BY TWO DIFFERENT GROUPS ON THE HOTZ SCALES, SERIES A (INDIVIDUALIZED INSTRUCTION 7½ MO.)

Scale	Add. & Sub.		Mult. & Div.		Equa. & Form		Problems		Graphs	
Group	Slow	Normal*	Slow	Normal	Slow	Normal	Slow	Normal	Slow	Normal
Median	7.4	7.8	8.1	8.2	8.4	8.6	6.6	6.8	7.5	7.5
Tentative Standard	7.9		7.9		7.8		5.8		5.6	

*The Reorganization of Mathematics in Secondary Education: p. 349.

TABLE IV. SCORES MADE BY TWO DIFFERENT GROUPS ON THE DOUGLASS DIAGNOSTIC TESTS, SERIES B (INDIVIDUALIZED INSTRUCTION 7½ MO.)

Test	Fractions		Form. & Frac. eq.		Graphs		Quadratics	
Group	Slow	Normal	Slow	Normal	Slow	Normal	Slow	Normal
Median	3.1	3.4	3.1	3.3	3	3.2	3.3	3.6
Tentative Standard	2.4		3.2		2.5		3.4	

TABLE V. SCORES MADE BY 55 PUPILS AT THE END OF 4½ MONTHS ON THE HOTZ EQUATION AND FORMULA SCALE, SERIES A (INDIVIDUALIZED INSTRUCTION)

Median	6.9 (Four and one-half months)
Tentative Standard	7.1 (Six months)

standard of the measuring instrument, is it not sufficient evidence to allow us to conclude that for the normal pupils individualized instruction showed improved results?

What do we find for the slow pupils? Table I (Individualized instruction) shows a median score of 7.3 and Table II (Group instruction) shows a median score of 6.1. Also the variation in time is the same as that in the above situation. From these data we should be safe in concluding that individualized instruction of this type offered a situation which was quite advantageous to the slow pupil. When one group can attain a standard that is 1.2 above that of another (we have only one way of determining its significance; the score of 6.1 is practically midway between the standards for the 3 and 6 months groups, whereas the score of 7.3 represents a gain over the 6 months group of one-fourth of the difference between the 6 and 9 months groups) and do it in one and one-half months less time, it seems to be evidence enough to warrant a conclusion that the results have been improved.

Finally, let us examine the results of the second year as they are given in Tables III, IV, and V. In this instance there was no

opportunity to compare results with comparable groups. All that could be done was to control the conditions and measure the results by the Hotz Scales and the Douglass Tests and on the basis of time spent. Here we find about the same story that the former year's work told. In every instance except on the Hotz Addition and Substraction Scale we find that the normal group surpassed the standard. Also, the slow group showed superiority on all the tests except the Hotz Addition and Subtraction Scale and the Douglass Formula and Fractional Equation Test. These items are quite explainable by the fact that these tests contain materials which are not taught in the progressive schools at the present time. Then from these results we would say that on the whole the pupils under individualized instruction showed improvement over the standard. Here again we have the data representing seven and one-half months of instruction as against the standards for nine months.

IV. Summary.

One type of adjustment to individual differences in ninth-year algebra has been described: providing for strictly individual progress and a great amount of individualized instruction. The experiment reflects the almost universal recognition of the failure of the traditional methods to adapt procedure to individual differences. It illustrates an effort in fitting the school to the individual for whom the school exists.

Individualized instruction of this type stands for individualization, each pupil being recognized as a living human being and being taught as one who differs by right and necessity from every other human being, the variations being in his capacities, his activities, his needs, and in his contributions to his fellowmen. The technique calls for (1) the re-organization of the materials into very definite units of achievement, (2) the units to be self-instructive and self-corrective, and (3) a complete program of diagnostic testing.

The results of the experiment when evaluated on the basis of measuring attainments by performance on two of the best known and most popular standardized tests, and also on the basis of time spent, show that there has been improvement over the traditional procedure. They show that the normal pupil under individualized instruction may attain the same or even a better standard of success than other normal pupils under group instruction, and do it in one and one-half months less time. Also they show that the slow pupil under individualized instruction

can really learn algebra; that he may surpass the attainments of other slow pupils and in some instances may equal or surpass the standards established by the thousands who were selected at random for the purpose of giving us a measuring instrument; and that he may do it in one and one-half months less time.

PICTORIAL CHARTS FOR TEACHERS ISSUED BY DEPARTMENT OF AGRICULTURE.

In its scientific work the United States Department of Agriculture takes many photographs of plants and animals in various stages of development and under different conditions. Some of these pictures are being assembled in the Office of Agricultural Instruction into the form of printed charts for the use of teachers, who use the charts to illustrate certain phases of their class room work in agriculture and home economics. An arrangement has been made with the Superintendent of Documents, Government Printing Office, Washington, D. C., whereby thirty-two of these charts already completed may be purchased for one cent each. The titles of the charts are:

1	chart	Light breeds of horses	1 cent
1	"	Draft breeds of horses	1 cent
1	"	Dual-purpose breeds of cattle	1 cent
*1	"	General purpose breeds of chickens	1 cent
*1	"	Meat breeds of chickens	1 cent
*1	"	Egg breeds of chickens	1 cent
*1	"	Comparison of bacon and lard types of hogs	1 cent
*1	"	Breeds of sheep	1 cent
*1	"	Cotton producing areas and distributing centers	1 cent
*1	"	The cotton plant	1 cent
*1	"	Cotton improvement	1 cent
*1	"	Cotton production	1 cent
1	"	Pests and diseases of cotton	1 cent
*1	"	Ginning and marketing cotton	1 cent
*1	"	Four small grains	1 cent
*1	"	Production of small grain	1 cent
1	"	Pests of small grain	1 cent
*1	"	Harvesting of small grain	1 cent
*1	"	Grain marketing	1 cent
*1	"	The corn crop	1 cent
*1	"	Corn and corn plants	1 cent
*1	"	Corn production	1 cent
1	"	Pests of corn	1 cent
1	"	Seed corn	1 cent
*2	charts	Dairy breeds of cattle	each 1 cent
*2	"	Beef breeds of cattle	each 1 cent
*2	"	Harvesting corn	each 1 cent
2	"	Breeds of hogs	each 1 cent

*These may be of interest to home economics teachers.

New Lantern Slide Series.

Two new series of lantern slides on control of household pests have been completed by the United States Department of Agriculture. Series 60 shows pests destructive to property, such as food, clothing and furniture. Series 61 shows pests detrimental to health, either through carrying diseases or annoying man. These slides, prepared in cooperation with the Bureaus of Entomology and Biological Survey, are now available for distribution from the Office of Agricultural Instruction, Extension Service, United States Department of Agriculture, Washington, D. C. They will be particularly valuable for use in schools and by organizations such as women's clubs.

WALKING AND CLIMBING TOPS.

By R. C. Colwell,
West Virginia University.

The gyroscopic top when placed on a pedestal will rotate about the pedestal—due to the action known as precession. If the point of support is changed from A to B, (Figure I), the direction of the precession will be reversed. Thus when a spinning gyroscopic top is alternately supported at A and B, the top will have a forward motion much like a man walking.

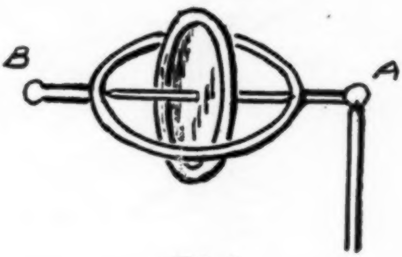

Fig. 1

The easiest way to swing a top alternately from one support to the other is to suspend it from two strings attached to A and B and to move it back and forth like a pendulum. Figure 2.

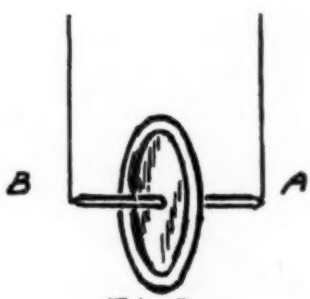

Fig. 2

The walking top is easily developed from that of Figure 2 by placing wire hooks at A and B and hanging the top on two concentric circular wires. (Figure 3). The wires are on a horizontal plane but M is supported on a spring so that the inner wire may

be alternately lifted above or lowered below the outer wire N. This is done by hand. When the top is spinning and rocked from one wire to the other, it will walk around the wires in a very life like manner. As the rotation of the top lessens, the precession becomes more rapid so that just before the top dies out, it will be running along the wires.

Fig. 3

The top in its precession moves both forward and upward, hence it can be made to climb a suitably designed ladder. In Figure 4, the two wires are bent into hook-like steps and arranged so that by a rocking motion, the top can be swung from one wire to the other. Its precession will carry it up the ladder. The motion is in one direction only however and the top while spinning in the direction for an ascent cannot be made to descend.

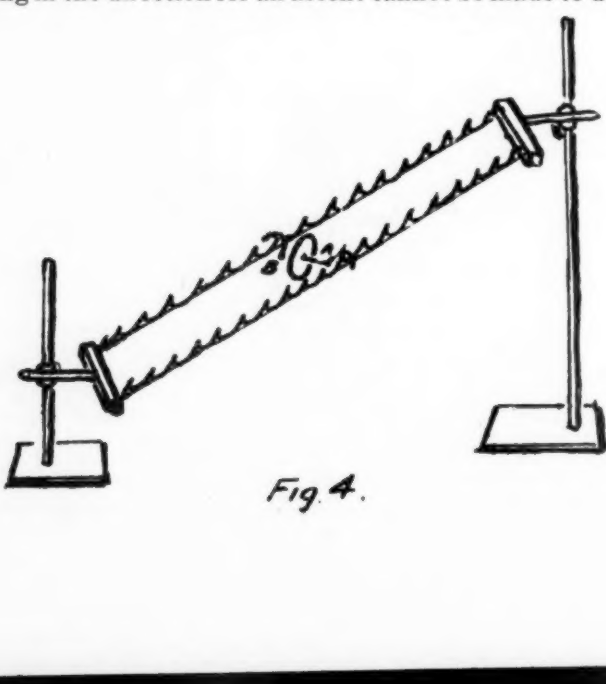

Fig. 4.

Another interesting little double top is shown in Figure 5. It consists of two gyroscopic tops soldered together with their axes at right angles. When both tops are set spinning in the same direction the two rotations will have a component rotation about A so that the whole top will spin about A: if however, the two tops are acting in opposite directions the two rotations balance out and the top falls down as if it had no rotation at all.

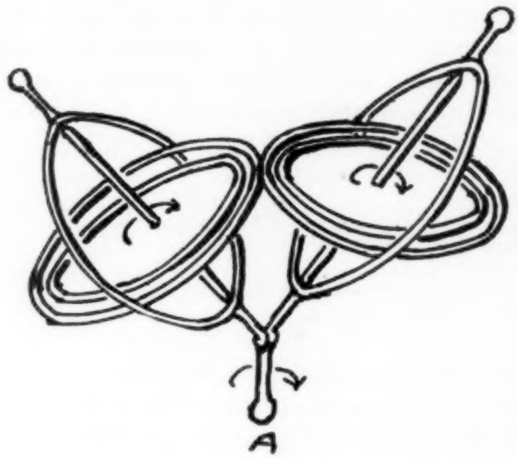

Fig. 5

SIXTY-FIVE GIANT SPRINGS.

To be included in the list of the largest springs in this country a spring must yield at least 65,000,000 gallons of water a day, on the average. The 65 springs that are known to be eligible for the honor have been studied and described by Dr. O. E. Meinzer, of the United States Geological Survey. Any one of these springs turns out enough water to supply a city the size of the national capital. The largest yields almost enough to meet the needs of a city like New York.—*Science News-Letter.*

LUTHER BURBANK HONORED ON ARBOR DAY.

Arbor Day is observed in California on March 7, the birthday of Luther Burbank. Before his death last March Mr. Burbank requested Stanford University to take over his experimental farm in Sonoma County and to make provision for the continuation of his work. This suggestion has since been renewed by Mrs. Burbank. A committee, with Paul Shoup, vice president of the Southern Pacific Co., as chairman, has been formed, with the ultimate purpose of establishing at Stanford University a foundation to provide funds for the continuance of the notable work of Mr. Burbank in plant breeding.—*School Life.*

A STUDY OF CHEMISTRY EXAMINATION QUESTIONS GIVEN BY VARIOUS STATES AND CITIES IN THE MIDDLE WEST AND EAST.

By EDITH GARNER,

Fremont High School, Oakland, Calif.

Thirty-three different examination papers were examined. The number of questions on each paper ranged from five to fifteen—a very few giving only five, and where there were a greater number of questions a choice was usually given. The questions numbered 382 and were first divided into the following groups for comparative study:

TABLE I.

Type of Question		*Number*	*Per cent of All*
(1.)	Problems	51	13.32
(2.)	Commercial and Industrial Chemistry	59	15.4
(3.)	Memory tests (Define terms, etc.)	91	23.8
(4.)	Laboratory	68	17.8
(5.)	Use of symbols, formulas, etc	70	18.32
(6.)	General Discussions	29	7.5
(7.)	Miscellaneous	14	3.6

After making the general classification of questions as a whole, each question was studied and each part of the question listed separately. For example, a question may ask for the preparation of calcium and two of its important compounds. The first part would be listed under elements and the latter counted as two questions under compounds. Likewise each formula and each equation was listed separately as was each term to be defined or law stated.

The following tables give the results of this listing:

TABLE II.

Types of Problems	*Number*
Gas Laws	11
Involving Equations	23
Per cent Composition	14
Det. wt. of 1 cc. of Substance	1
Change F. degrees to C. degrees	1
Find Molecular wt	1

The results of tables 3, 4, and 5 are included in Table 1 under headings, Commercial and Industrial and Laboratory Chemistry. The questions on different elements and compounds total 71 while the total number of questions involving elements, compounds, and tests, Column 1 of Tables 3, 4, and 5, total 201. This number of questions in Table 1 under Commercial or Industrial and Laboratory Chemistry, totals 127. The difference in totals is due to the fact that in Table 1 only questions

TABLE III.

Elements—This Includes Preparation, Properties, and Uses.

Number of Questions	*Number of Different Elements*	*General Questions on Elements*
69	21	4

Order of Greatest Number of Times Occurring.

Element	*Number*	*Element*	*Number*
Chlorine	12	Carbon	2
Iron	10	Gold	1
Oxygen	7	Silver	1
Hydrogen	5	Phosphorus	1
Nitrogen	4	Sodium	1
Sulphur	4	Silicon	1
Lead	3	Mercury	1
Zinc	3	Magnesium	1
Copper, Aluminum	2	Antimony	1
Platinum	2	Calcium	1

TABLE IV.

Compounds—Preparation, Reason for Method Used and Uses.

Total Number Questions	*Number of Different Compounds*
86	50

Order of Greatest Number of Times Occurring.

Compound	*Number*	*Compound*	*Number*
Ammonia	8	Sodium Carbonate (Solvay)	3
Coal Distillation	7	Soap	3
Nitric acid	4	11 Compounds	2
Carbon dioxide	4	35 "	1

TABLE V.

Testing for presence of unknowns either the elements, radical as (NO_3) or a compound as Nitric oxide.

Total Number of Tests	*Number of Different Tests*
46	30

Order of Greatest Number of Times Occurring.

Test	*Number*	*Test*	*Number*
Sulfate	6	Carbonate	2
Chloride	5	Sodium	2
Carbon Dioxide	3	Nitrate	2
Fehlings	2	22	1
Ferric	2		

as a whole were considered, whereas in Tables 3, 4, and 5 each part of the question has been listed separately.

In the study of questions listed in Table 1 as Memory Tests, there are included all defining of terms and stating of laws and hypotheses. Sometimes one question would call for the defining of several terms and in this table each term has been listed separately.

Heading 5 in Table 1 has been subdivided into two parts: Part One, questions dealing with formulas and symbols, and Part Two, equations.

TABLE VI.

Number of Terms, Laws, etc.	*Number of Different Terms, Laws, etc.*
146	79

Order of Greatest Number of Times Occurring.

	Number		*Number*
Acid	11	Formula	3
Valence	10	Guy Lussac's Law	3
Base	8	Ionization	3
Salt	7	Law of Mult. Pro.	3
Boyle's Law	4	Periodic Law	3
Avogadro's Hypothesis	4	15 terms occur	2
Compound	3	51 terms occur	1
Dalton's Atomic Theory	3		

Under Part One, the questions were the formula given to name the compound; to write the formula when the commercial term such as blue vitriol, quick lime, etc. was given; write the formula when the chemical term such as calcium carbonate was given or to name the constituents when the name of the substance was given.

Of these there were 158 questions listed and of this number, twenty-five per cent were organic compounds. However, these numbers include repetition of the same terms.

The total number of equations listed was 138. In this number were included the equations called for along with laboratory and commercial preparation of elements and compounds, which, however, were not a very large per cent of the 138.

The reactions were classified as follows:

Equations involving reaction of acid and salt	17
Equations involving reaction of acid and base or base oxide	19
Equations involving reaction of salt and salt	8
Equations involving reaction of salt and base	3

The other equations include:

Decomposition of compounds by heat.

Metals and acids (other than H_2SO_4 and Cu or HNO_3 and Cu).

Active metals and water.

Oxidation and Reduction.

Replacement of less active element by more active.

Out of the 138 equations, 25 involve the use of sulfuric acid and 7 nitric acid. The reaction of copper on sulfuric acid occurred three times while the reaction of nitric acid and copper occurred four times and nitric acid and silver once.

The questions listed under general discussions, included the following: 8 questions involving explanation of facts by means of hypotheses. 8 questions involving a detailed explanation of

Oxidation and reduction. 13 questions involving synthetic processes, electrolytes, nonelectrolytes, etc.

The miscellaneous group of fourteen questions includes the following:

Air and ventilation	4
Absorption of gases	2
Historical	1
Chemistry of Health	1
Colloidal suspension	1
Det. of wt. of a liter of gas	1
H-equivalent of magnesium	1
Removal of Stains	1

From the study of these examination questions one would be able to get a fairly good idea of the Chemistry being taught, probably quite as good as from questionnaires sent out to various teachers.

RADIUM GIFT USEFUL.

The gift of one twenty-eighth of an ounce of radium, worth $100,000, made by the women of America to Madame Curie in 1921 has been instrumental in establishing and proving a new law of nature.

Mme. J. S. Lattes, a worker in Mme. Curie's laboratory, has described in Annales de Physique, her studies of filtering of radium rays.

Madame Lattes was originally interested in finding the best method of wrapping up the applicator tubes which are brought in contact with the flesh of a patient who receives radium treatment, but her results led her into fundamental studies of the absorption of radium rays by different materials. She was able to confirm definitely, using the American radium, a law discovered last year by Georges Fournier in the same laboratory, according to which there is a simple mathematical relation between the absorption coefficient of a material and its atomic number. She also attained her original object, for she learned how to avoid the destruction of the flesh, or necrosis, which occurs when a radium tube is improperly used. Essentially her method is to use first a thin sheath of a dense metal, such as platinum, around the radium, and then to wrap the tube in many layers of light material, such as gauze, to absorb the secondary rays issuing from the platinum. This method which has also been developed empirically is now for the first time clearly understood and explained.

In her latest report, published in the Annals of the University of Paris, Madame Curie tells of the great and growing activity of the group which she directs. No less than thirty investigators are studying different problems of radio-activity, and fifteen scientific papers were published from the laboratory between November, 1925, and May, 1926. In addition, the various technical services of the laboratory have been kept up. Madame Curie's daughter, Dr. Irene Curie, who accompanied her mother on her visit to this country, is one of the most productive research workers at the Radium Institute, and also has charge of some of the laboratory teaching.—*Science Service.*

SLOGANS IN THE TEACHING OF ARITHMETIC.

G. W. Myers,

The University of Chicago.

One of my teacher friends, who is also one of the best teachers of arithmetic I have ever seen teaching, writes me that he is utterly disgusted with the modern fad of "sloganizing" in the teaching of arithmetic. Let us look into this matter a little. Maybe my friend's feeling in the matter is justifiable, but I beg leave to be doubtful about it.

Webster says of slogan that it is "the war cry or gathering word of a Highland clan in Scotland; hence any rallying or battle cry."

Some one has told us that the reason the "old songs" are so much loved by us and are so appealing and stirring is because "they are the rallying cries of memories, memory's slogans." No one will deny the effectiveness of the "old songs" in stirring the will and activating both individual and group conduct.

During the World War we learned the effectiveness for mass action of many slogans. The sales campaign for Liberty bonds was materially aided by slogans and by cartoons that were merely pictorial slogans. "Make the world safe for democracy" is an example of a slogan. The slogan, "He kept us out of war," was perhaps a leading factor in carrying a national election not so long since. Many of our compatriots heeded the "buy till it hurts" slogan.

Religious bodies put over their "drives" for funds largely through the aid of slogans. This religious group must have a better equipped plant calling for augmented funds that it may do more "to make democracy safe for the world" and that other group must have increased funds to be able to say more effectively to the evolutionary heresy: "Thou shalt not pass."

Fundamentally, most people think, reason and conduct their lives, guide themselves through life's crises through slogans and adages which are only inherited slogans. Criticise and complain of it as we may, most childish people such as compose the bulk of our citizenry and all children think always in labels, catchwords and slogans. It is the mark of a very high degree of culture to be free from these substitutes for principles. In the elementary public school we must come down to where the children live and approach pupils with what appeals to them as children, leaving the trueing up of their appreciations for sound ration-

alizing to the leisurely maturing procedures of adolescence and adulthood. Preadolescent children are particularly susceptible to the slogan appeal.

The political bosses, those experts of community leadership for good or ill, are fully alive to the effectiveness of sloganizing their constituencies. They are sleepless in their search for a slogan to "put across" the issues of the forthcoming campaign. Who will not agree that the time-worn, though still the favorite political slogan, "He reduced the taxes" is more effective than all campaign eulogies, with the man in the street? The only successful means of defeating a well-sloganized campaign, is to sloganize the opposition.

This morning's newspaper tells us that Chicago needs a slogan. New Orleans advertises herself as "the world's most interesting city," Clearwater, Fla., never forgets to say "it's always springtime in Clearwater" Atlantic City calls itself "the playground of America," Bridgman, Mich., displays through her ample environs that she is "the biggest little town in Michigan," and Chicago should say of herself something like: "The convention city of America," or "The Athens of America," or anything else that is both good and true to the end of "doing much to build up a better opinion of Chicago, the world over." Furthermore, a good slogan will neutralize the bad one, "the most lawless American city." Chicago already seldom fails to use her "slogan" "I will" to put local issues through successfully.

The state mottoes are only slogans. To move masses of men to act for desired ends, good or bad, nothing known to successful leadership is so effective in getting issues to stick and to influence conduct as pithy and catchy slogans. The slogan influence is primitive, instinctive. It is therefore even more appealing to children than to adults. Then why not use it "to sell" the subject or topic in hand in arithmetic teaching? To quarrel with what is instinctive would seem shortsightedness in dealing with the direction of child activities. To cherish the Utopian idea of replacing the slogan motive with children by the cold formalism of scientific reasoning, is futile. The best treatment for the tadpole's tail while he has a tail, has long been known to be the best thing for the frog, even though he has lost his tail.

Since all are so constituted as to be powerfully stimulated to efficient action through slogans, since the first duty of good arithmetic teaching is "to sell" the worthwhileness of the determination to master the problems of arithmetic learning to the

learner and the wise use of mnemonic slogans is the readiest known means of doing it, and since we want vigorous, purposive action aroused in arithmetic learning, why should we not imitate the prudence of successful leadership by sloganizing fundamental concepts and essential processes, not so much for the "thrill" as for the "stick" and the inevitable natural response it provokes?

Tersely formulated laws are only sloganized laws. These sloganized laws are the compacted essentials, supplied with "hook-ups" for memory. They give one the kernel in its shell, or better perhaps, with the shell already well cracked. They are capsuled remedies for easier ingestation and for proper assimilation. But this does not make quack remedies of slogans, for are they not studiously and competently prepared by the professional practitioner, the teacher?

Let us cite a few examples of the type of teaching slogan we have in mind. Whenever you see an "of" in factions think: "of means times in fractions." Also "of" with a number after it should always remind you: "times a number means 'of' with fractions." "Divided by a fraction means times the inverted fraction" is another good tocsin. "Per cent of means decimal times" is highly helpful. "Safety first" may well signal a warning for the right mastery of the core-point, the crux, of some study unit. "Safety first" with problem work will usually do more to impress the pupil effectively with the need for checking his work than will any amount of moralizing about its importance. "Ft. by ft. give sq. ft." and "Ft. x ft. =sq. ft." are both worthy memorization slogans. "Look before you leap" is a caution always in point in the "hard spots." Properly observed, it will often remove much mere pencil-puttering. These few samples will suffice to make definite the type of thing we have meant by slogans in arithmetic teaching.

Nor should the sedate and serene science of algebra in its earlier stages regard it as degrading to employ slogans as "sales instrumentalities" as well as means of fixing fundamental reference points for later use in organizing its doctrines. We list here a few good slogans for use in algebra teaching:

"Arithmetic numbers, symbols and laws have the same meanings in algebra,"

"In algebra the plus and minus signs may be either verbs or adjectives,"

"Factor means divisor,"

"The factors of a number are its *makers* by multiplication."

"To subtract, change sign of subtrahend and add,"

"In multiplication and division, like signs give positive, and unlike signs negative products."

"To divide, invert the divisor and multiply,"

"To transpose means swap sides and change signs."

The list of frequently recurring ideas and techniques can of course be easily extended. The deeper significance of these terse even if partial statements of truth, first used as slogans, will gradually dawn on the learner through frequent correct usage, and shortly they will come to be recognized and "felt" by him as principles. The pupil very rapidly grows into a liking of a subject in which he can do things correctly, even when he feels shaky as to the underlying reasons for their soundness. Thus it is that the use of many early sloganized procedures is an effective means of selling the study of algebra, much sooner than can be done by continual insistence of logical adequacy.

The conclusion as to the legitimacy of the use of slogans in arithmetic teaching would seem to be that they are legitimate for the following reasons:

1. They are instinctive modes of child thinking,
2. They greatly aid in fixing in memory what must be memorized,
3. Their terse pithiness impresses the learner early with their import of meaning,
4. They greatly facilitate handy reference to oft-recurring things, and
5. They are a most powerful factor in "selling" the worthwhileness of subjects, topics and principles at a much earlier stage of study than insistence on rational insights alone can possibly do.

We therefore favor more extensive sloganizing in both arithmetic and early algebra teaching—thus extending their field even beyond that suggested in the topic of this paper,—than is commonly practiced either in texts or classrooms today.

But the writer is asked: "Would you approve the vogue among early grade teachers of today of having the children learn to say they are now studying the 'Put togethers,' the 'Take aways' the 'Timeses' or the 'Goes intos,' distorted often into 'guzintus'?" His reply is "yes." These phrases all give the child ideas more near to the real meanings of the processes, than do the terms "add," subtract," etc. That the pupil fails even to see the correct significance of these slogans is due to the fact that we teach children numbers and arithmetic too early for any adequate insight into the meanings of processes. These phrases however mean much more to the children than some who find terror in the fact that some backward children have been reported to say "guzintus" for "goes intos" seem to think. The writer has known of the arithmetical experiences of many hundreds of early grade children, and never once has he met this distortion of "goes intos." He is disposed to call this the creation of the mind of some wag, more anxious to reflect disfavor on the work of the schools, than to state facts. This ridiculous distortion of

one slogan even if it ever occurred, is not likely to frighten the real teacher from speaking and having children speak in language that has meaning to children. Until the writer can see more reason for the contrary point of view than his first thirty years of teaching experience has shown him, he is disposed to say: "The more sloganizing in arithmetic teaching the better."

DIABETES COMMUNICABLE

That diabetes, heretofore considered a disease of disarranged metabolism, is caused by an ultramicroscopic germ or filterable virus is suggested by experiments on rabbits by Dr. D. H. Bergey, professor of hygiene and bacteriology of the Unitersity of Pennsylvania.

By infecting rabbits with carefully filtered secretions from diabetic patients, Dr. Bergey was able to produce the first stages of diabetes in the animals. He also found that the infective agent increases in strength when it is cultured in broth, just as well-known visible germs do.

Dr. Bergey calls attention to the astounding doubling of the diabetes death rate in the first twenty-three years of this century and declares that since neither bacterial nor protozoal cause for diabetes mellitus had been discovered, this increase "indicated some definite toxic action and suggested the possibility that a filterable virus might be the responsible agent."

Dr. Bergey found that inoculated rabbits developed the diabetic symptoms of sugar in their secretions in one to three weeks and continued to show sugar at irregular intervals, indicating that diabetes had set in.

"The fact that the virus causing diabetes mellitus can be cultivated," he says, "opens up the way for the development of specific prophylactic and therapeutic measures against this disease. Time has not been available to develop this line of investigation but it is hoped that by bringing the results of this preliminary study to the attention of other investigators work in these several fields will be stimulated.

"There is no doubt that systematic study of the blood of normal and inoculated rabbits will aid in the solution of the problem of the etiology (cause) of diabetes and at the same time elucidate the irregularity of the appearance of glucose in the urine of inoculated rabbits.

"More detailed study of the pathology of this infection in rabbits is also needed to determine whether the changes in the pancreas and other internal organs are similar to those in man. For this study, it will be necessary to keep inoculated rabbits under observation for a year or more so as to permit the development of alterations in the pancreas and other internal organs.

"The relation of the form of diabetes in children which is often rapidly fatal to the slowly progressing disease in adults may also be elucidated through experiments on animals."

In diabetes the function of a portion of the pancreas, called the islands of Langerhans, is deficient and does not promote the utilization of the carbohydrate foods eaten. Insulin, a great boon to diabetics, is made from the animal pancreas and substitutes for the normal function of the human gland. Although insulin, the discovery of Banting and Best, has saved the lives of many patients, the cause of diabetes has been unknown.—*Science News-Letter.*

Participation of the Federal Government of Brazil in the diffusion of primary education was established by a recent Executive decree, which organized a national department of education and reorganized secondary and higher education. Heretofore public education has been controlled by the several States, and not by the Federal administration.

"A PLEA FOR HIGH SCHOOL GEOGRAPHY."

By Thomas H. Finley,
Austin High School, Chicago, Ill.

Man is inseparably connected with the soil. It is his home—his means of living—his store house of research—his "El Dorado" for all his luxuries—his birthplace and his last resting place. "For dust thou art, and unto dust shalt thou return."

Since man is so closely bound to the soil or earth, and since geography is the study of the earth in its relation to man; it follows naturally that the subject of most vital concern to man and his interests is the subject coming nearest to his life and material destiny.

Curriculum reconstructionists tell us that the future will develop a curriculum that will enable the child to live the experiences in school which he will live in life. Is it possible to conceive of a curriculum ignoring the fundamental relationship of man? I cannot conceive of such a curriculum—neither can a host of social science workers who place geography as the basis of the social sciences.

I know of no subject that deals so largely with world problems. I know of no subject that can reckon so entirely with living conditions of a people. Such a subject must deal with the environmental situations in which a people find themselves.

I am keenly aware of the action of some educators in ignoring geography in the construction of their curriculums. I am also aware that some educators are shouting, "Too Much Geography," in the curriculum today. I am as thoroughly convinced, as I am cognizant of the present situation, that curriculums built on other foundations than geography as one of the foundation stones will be shortlived. I believe such curriculums will serve to bring more vividly to the surface the essential features of any curriculum giving the training necessary to broader and higher living.

A recognition of natural law is imperative in any scheme of training for citizenship. Geography is a study of facts based on natural laws of climate, latitude, topography, soil, etc. The past will show that man's success in all lines of endeavor has been measured by his observance of natural law.

May I again refer to the educator who seems to be surfeited with the present amount of geography in the curriculum. I am inclined to think it is the kind rather than the amount that is causing the uneasiness in his educational digestion. Within the

past 18 months I read an article in which the author was deploring the fact that no "minimum essentials" in geography had been developed. You know we have developed a "minimum essentialitis" in the past few years. Prof. Jones could have 75,000 boys and girls in four separate states write themes on various subjects and deduce some fairly accurate data on the vocabulary of eighth grade pupils. A similar process has summarized essentials in arithmetic. A resume of my boyhood speller reveals it contained 20,000 words for my attainment as a citizen. That number is easily four times my actual vocabulary. A similar study of my boyhood geography reveals information entirely opposite in character. To entertain the thought that geography can be circumscribed in content, as spelling is summarized, is to admit a lack of knowledge of the place geography must play in the life of the world citizen.

Business men and corporations are stressing the importance of a wider knowledge of geography for all young people entering the business field. A study of the publications of such men and corporations will point clearly the utter lack of common geography, and superficial knowledge (if any at all) of peoples of the world, among all classes of business men. Are we improving in a better geographical education?[1] Prof. Mears of Stanford University implies we are not. In testing 112 students (sophomores and juniors) in the commerce course he found them woefully weak in common geography. The questions were on latitude, longitude, capitals of important countries, world cities, and distances between important world ports. One-half of the questions were answered correctly by one-seventh of the class—three persons of the 112 were marked 70 per cent. The results may be exceptional—I hope they are. Prof. Mears closes his summary with the following: "Yet a speaking acquaintance of world centers, of channels of trade, and shipping is the most elementary requirement of any educated person who intends to embark on a life long foreign trade career. And it is scarcely less important for the student of world affairs."

Conservation is a field for high school geography. J. Russel Smith compares Europe and America in terms of opportunities. Are the past comparisons to continue? Can you tell me where my young farmer friend can obtain a good farm for $1.25 per acre? Our free land is gone. A study of the 1920 census will

[1]School and Soc. 20:286. August 30, 1924

uncover the fact that the rural population declined approximately 10 per cent from 1910. The entire population increased 10 per cent—the net result is more consumers and less real producers. We are rich by inheritance—we are living riotously on that inheritance.

We are a nation of travelers. The automobile has increased the already large list of tourists. A camping ground at Denver had a daily population of 2500-3500 and the population changed on the average every two days. The state ot Wisconsin, according to a newspaper item, estimated an income of $9,000,000 in 1925 from tourists. What an addition to the joy and value of the multitude of parties touring if the members knew a bit of essential geography relative to their own country before starting on such a journey.

A hasty glance through the columns of a metropolitan daily will indicate the absolute necessity of a knowledge of world geography. Time and space have been eliminated. and we find ourselves world citizens whether we will it or no. That world citizenship in advantage carries with it a corresponding responsibility.

The place of changing conditions that is paramount is the growing unity of economic relationships. World trade is essential today if it is not a necessity. The current publications of farm bureaus, manufacturers' associations, of business men everywhere stress the fact that our continued economic prosperity will depend upon the relation we establish and maintain with foreign countries. Profit or loss to the American farmer is often determined by the price of 15 per cent of surplus wheat we produce annually. Whether it shall be profit or loss is many times determined by the Liverpool market. The United States uses 500,000,000 pounds of wool annually. Nearly one-half of this raw product must be imported. A disturbance of the wool conditions in Australia will effect the price of a wool suit of clothes next year. It may sound like a "far cry," but the relationship is direct.

Recent developments indicate a similar social relationship developing. A greater world social unity is developing whether we desire it or not. We must have a wider knowledge and a broader interpretation of current world happenings. High school geography must help to accomplish this task. Sec. Hughes during his last year of office as Sec. of State declared, "that

untruths concerning the peoples of the earth are the greatest hindrances to the country's foreign policies." We want a people who can look beyond propaganda for personal or corporate reasons and get a glimpse of the ideals, aspirations, and nationality of our neighbors. We want and ought to know our neighbors collectively and not an individual peculiarity. To know that the Chinese smoke the opium pipe does not give us any basis for judging the relation of Japan to China, or a sane discussion of the "open door" in China. A pernicious propaganda, carried on for months by a metropolitan daily against Japan, fell flat when Sec. Hughes made his forceful address in the Disarmament Conference. Sec. Hughes' address resulted in truth being uncovered and a trend of feeling changed. We want a citizenry with a knowledge of the peoples of the world based on the geographical setting of said peoples that will not permit of such misconceptions, put out by designing newspapers, to find lodgment in our common ideals.

The geography of the grades begins with the study of the peoples of the world in their habitat. The child is fond of finding out the status of children in other parts of the world. Here is a first step to a sympathetic and intelligent interest in the diferent peoples of the world. Such study should broaden the mental vision of the child, but unless guarded will leave the child with the peculiarities of the peoples studied rather than with the facts that lead to the action of the correct citizen. Such geography does not give the basis for evaluating the conditions that should determine our action as a world power to other nations. High school geography must give the essential setting. The experience and mental development of the grade child does not permit him to reason interpretatively. This lack of development makes it impossible to place upon the grade child the necessary facts and principles to give a basis for understanding world relationships.

For many reasons—some of which have been enumerated—I believe at least one-half year of geography should be required of every student in the high school. This semester of geography would come after the Freshman year. The amount and kind of material to be included in such a course would be difficult to determine. I doubt if there are any who are prepared to give a definite statement as to the content of such a course, and many who would shy at even an attempt. Such a course should be the work of a committee—representative in character—with no

time limit attached. The following list of topics should be included in any course of high school geography. This list is neither detailed, complete, nor inclusive. A study of map interpretation; land forms and their surroundings; latitude comparisons; topography of land forms and its significance in the life of man; climatic environment and resultant; the relations of nations and regions as a result of climate and topography; the effect of isolation vs. commerce on the life of a people; the part transportation plays in the life of a people; the significance of an indented coast line; a comparison of the principal products of countries to establish the necessity for trade; the reasons for the production of certain crops in one community to the exclusion of others; the geographic basis for dense populations and problems attending such concentration; similarly for sparse populations; the geographic basis for race distribution; natural resources and effect on man; standards of people as a result of environment; and the interdependence of nations commercially and its effects.

Such a course will demand the study of place geography since the average high school student knows little or less real place geography. Such knowledge is essential and must precede successful thinking interpretatively and environmentally of man in relation to his home.

Commercial students should have a full year of geography. The course should cover the material mentioned for the entire student group with additional work on the importance and geography of all the industries. Such a course should include a study of the various industries—agricultural, mining, herding, manufacturing, trade and transportation. Each industry should be studied in its contribution to man's life and happiness. The study must include the location of the producing regions with reference to latitude, topography, climate, soil, methods of cultivation, difficulties of production, problems of marketing, reasons for intensive and extensive agriculture, the various phases of the industry and their relation to the industry as a whole and to man. In this course a liberal amount of place geography is not only desirable, but imperative to the success of such teaching. The student cannot think in terms of reasons without having definite knowledge of the places and locations that occupy his thought. Each of the industries should be studied in a similar manner varying the topics to suit the conditions and usefulness of the industry.

The geographic location of peoples and the developmental environment of groups must not be overlooked. Although people are inseparably connected with industry and must be studied with the industries there is a phase of human life independent of industry and such an aspect of human life has its geographical setting.

In addition to the work in the industries each country of the world should be viewed in its individual industrial and commercial setting. A natural explanation of its imports, exports, balance of trade, and its commercial importance among the nations should be made. A deduction as to whether the country is being developed to capacity, or whether it has future possibilities for additions to man's needs and happiness should be observed.

I might proceed to enlarge on the other important industries and their sub-industries with their geography and causal relation, but enough has been said in this paper to give a hint as to the contents of a course in high school geography that will hold its own with any subject in the development of the seven cardinal points of education.

James Bryce in defining democracy says: "It (democracy) assumes not merely intelligence, but intelligence elevated by honor, purified by sympathy, and stimulated by a sense of duty to the community." The subject under discussion not only adds to the intelligence of the individual by furnishing geographical and commercial knowledge, but it is potent in developing sympathy since true sympathy is exercised only when we know at first hand the condition of our neighbors. The study of high school geography will give us the needed information relative to the lives of the peoples of the world and the causes for such conditions as exist.

When those new curriculums—dreams today—are realities tomorrow I confidently expect geography to be a prominent factor in the success of that much vaunted curriculum. A subject which cultivates a healthy interest in the future of the world, furthers imaginative activity, gives material for leisure hours, and cultivates an interpretative attitude of mind cannot fail to place when the rush for position starts. Our subject will be a part of the propeller as well as the keel when the new super-curriculum is launched. Allow me to predict it will be a basic factor in the safe voyage of that much talked of curriculum.

PRESENTATION OF THE ADDITION OF POSITIVE AND NEGATIVE NUMBERS BY MOTIVATIONS.

By Hildegarde Romberg,
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The following method of presenting the topic "The Addition of Positive and Negative Numbers" by motivation to a 9B class in Algebra has been used by the writer with gratifying results. The procedure separates the topic into three natural divisions: I. Positive and Negative Number Defined, in which the topic is motivated by correlating it with everyday experiences: II. Addition of Positive and Negative Numbers, in which is developed the three laws of Algebraic addition by correlating it with Arithmetic: III. Assimilation Period, in which pupil applies knowledge obtained in II.

The method in detail, is as follows:

I. Positive and Negative Quantities Defined.

A. Almost daily each one of us is asked, during the course of conversation to describe objects, persons, or conditions. The weather is referred to as warm or cold, height of persons as short or tall, speeds of automobiles as high or low. It will be noticed that the descriptive words are opposite in nature and express the quality of the object described.

Likewise in Algebra we have occasion to refer to quantities such as: a. Deposits, withdrawals. b. Incomes, expenses. c. Gains, losses, which are also opposite in nature and express the quality of the action. That is, the first action of the groups has an increasing effect, whereas, the second action of the groups has the opposite or decreasing effect.

B. From this discussion the pupils comprehend the nature of the quantities as shown by the list of opposites they will suggest when asked. These suggested opposites are listed in two columns, headed increasing and decreasing, using a, b, and c of above as first three, e.g.

Increasing (+)	Decreasing (−)
1. Deposits	1. Withdrawals
2. Income	2. Expenses
3. Gain	3. Loss
4. Credits	4. Debits
5. Above Zero	5. Below Zero
6. Upward	6. Downward
7. Positive Pole (Battery)	7. Negative Pole
8. Receiving	8. Giving

etc.

Teacher: "How in Arithmetic do we increase or enlarge a quantity?"

Pupil: "By adding to it."

Teacher: "In Arithmetic how is adding indicated?"

Pupil: "By plus sign. (+)"

Teacher: "Then we shall call these increasing quantities plus (+)."

Likewise:

Teacher: "How in Arithmetic is a quantity made smaller or decreased?"

Pupil: "By substraction."

Teacher: "What is the sign for substraction?"

Pupil: "Minus sign."

Teacher: "Then the decreasing quantity will be called a minus (−) or negative quantity."

C. This discussion is followed by pupils giving the Algebraic number of a list of integers as $5, +5, -5$. At this point introduce the term "absolute value" for a number as used in Arithmetic.

II. Addition of Positive and Negative Numbers.

For uniformity, pupils are to think of a positive quantity as receiving a certain amount and a negative quantity as giving away a certain amount.

A. Adding two Positive Numbers.

$$\begin{array}{r} +\$5 \\ +\$3 \\ \hline +\$8 \end{array} \qquad \begin{array}{r} +9 \\ +8 \\ \hline +17 \end{array} \qquad \begin{array}{r} +6 \\ +7 \\ \hline +13 \end{array} \qquad \begin{array}{r} +25 \\ +18 \\ \hline +43 \end{array}$$

Teacher: "If you received for your birthday from an aunt \$5 (positive quantity) and from a friend \$3 (positive quantity), how much did you receive?" (Note above examples.)

Pupil: "Eight dollars."

Teacher: "Receiving a certain amount is indicated how?"

Pupil: "Plus sign."

Teacher: "Therefore result is positive eight."

After four or five examples like the above, the pupils in each case working out result, the teacher asks pupils to observe as the addends are connected to answer and in a similar manner the signs of addends to the sign of answer. (Note above examples.) Upon asking pupils to state in their own words how to add two positive numbers, there will seldom fail to be a response. After two or three individual rules have been formulated,

the concise rule may be stated by the teacher, which at this point, really means more than a mere collection of words.

B. Adding two Negative Quantities.

The pupil is now to put himself in the position of the giver instead of the receiver.

$$\begin{array}{r} -\$.02 \\ -\ \ .05 \\ \hline -\$.07 \end{array} \qquad \begin{array}{r} -\$.25 \\ -\ \ .70 \\ \hline -\$.95 \end{array} \qquad \begin{array}{r} -95 \\ -68 \\ \hline -163 \end{array}$$

Teacher: "Each pupil is asked to contribute \$.02 a week to room flower fund (negative quantity) and to buy the school weekly for \$.05 (negative quantity). How has this affected the pupils financial standing?"

Pupil: "Reduced it 7 cents."

Teacher: "Reducing or decreasing is indicated how?"

Pupil: "Minus sign."

Teacher: "Therefore result is a negative seven."

Again after several examples as above are given, the addends are connected with answer and the signs of the addends with the sign of the answer, the pupils are able to formulate the rule for adding two negative quantities in their own words. To test their rules a few more negative combinations are solved.

C. Adding a Positive and Negative Quantity.

The preceding development has interested the pupils to the extent that the last combination, adding of Positive and Negative quantities is invariably suggested by pupils, and for its treatment, the students' financial standing is again considered.

$$\begin{array}{r} +\$10 \\ -\$\ 4 \\ \hline +\$\ 6 \end{array} \qquad \begin{array}{r} +8 \\ -5 \\ \hline +3 \end{array} \qquad \begin{array}{r} -17 \\ +29 \\ \hline +12 \end{array} \qquad \begin{array}{r} +33 \\ -52 \\ \hline -19 \end{array}$$

Teacher: "For Christmas John received \$10 (positive quantity) but soon spent \$4 (negative quantity) for a pair of skates. How has this purchase affected his financial standing?"

Pupil: "He still has \$6."

Teacher: "Then the result must be plus six (+6)."

Several additional problems may be solved and again during the time that the addends are connected with answer, many pupils will be eager to give in their own words the method for adding a positive and negative number.

III. Assimilation.

A. The attention of pupils is then directed to problems in-

volving all combinations, which have previously been written on the board as:

$$\begin{array}{r}+9\\+8\\\hline+17\end{array}\qquad\begin{array}{r}-7\\-18\\\hline-25\end{array}\qquad\begin{array}{r}-6\\+28\\\hline+22\end{array}$$

(a) At first, pupils are to state the problem in words, e. g. "If I receive 9 dollars and 8 dollars I have received 17 dollars. It is positive seventeen for my financial standing has been increased."

(b) Referring to second problem above:

"If I give away 7 dollars and another 18 dollars I have given 25 dollars. It is negative twenty-five for my financial standing has been decreased twenty-five dollars."

(c) "If I give away 6 dollars and receive 28 dollars I have left 22 dollars. It is a positive twenty-two for my financial standing has been increased twenty-two dollars."

B. This is followed by pupils thinking the above statements and giving orally the answer.

The presentation requires approximately a forty-minute period and is followed by an assignment from the text-book. The results of a test will justify the effort and time spent in presenting this topic always difficult for the beginner in Algebra.

MEASURE MAGNETISM OF ATOM.

The United States is forging ahead in the field of atomic physics where the brilliant theories of the Germans and Scandinavians have long held more or less undisputed sway. Experiments recently completed at Urbana, Ill., by Drs. J. B. Taylor and T. E. Phipps in the department of physical chemistry at the University of Illinois have produced results which throw a new angle on the quantum theory advanced by Dr. Neils Bohr, of Copenhagen, Nobel prize winner in physics, and that proposed by Drs. Max Born and W. Heisenberg of Goettengen.

Exponents of the German school have developed a theory that is based on a non-magnetic atom but the American scientists have found that the hydrogen atom is magnetic and have made a direct experimental determination of the degree of magnetism it possesses. They found that it was equal within the limits of experimental error, to one Bohr magneton, or unit of magnetic moment based on the Bohr quantum theory.

The atoms of the alkali elements such as sodium and potassium are known to behave as tiny magnets and since hydrogen is the simplest of all the chemical elements, knowledge of the degree of magnetism possessed by its atom is of great importance. All of the accepted theories of the continental school account for the spectrum of hydrogen accurately, in consequence of which a test of the nature of the hydrogen atom is of great scientific interest.—*Science Service.*

CURIOUS PLANTS AND ANIMALS THAT MEN EAT.*

By Clarence L. Holtzman,

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"Tell me what you eat and I'll tell you what you are" may be paraphrased "I'll tell you where you are," for our daily menu tells both who we are and where we live.

Kombu and kanten, iguana and Iceland moss all grace the table of some man, somewhere, in the day's round, while the luxury of one region is the staple of another and taboo of the Brahmin is the feast of the Briton.

Japan leads the world in utilizing algae. Their dish, kombu, is made of brown algae raw, cooked, dried, salted, or dyed, with soup, fish or soy beans.

The red alga, porphyra, is both bread and meat, for when made into sheets, it serves as the basis of the Japanese boy's lunch. These sheets are covered with layers of cooked rice and fish; then rolled into an inviting luncheon preparation.

Agar is becoming better known as a laxative than a culture medium. Served with cream, it is supposed to absorb water and furnish the bulk desired. Did you ever try Irish moss pudding? Then you are not qualified to blarney about the beauty of the New England shores. Massachusetts harvested over 33,000 dollars worth of Chondrus in the year 1902.

Every Swedish fish market carries dulse. Boil it with milk or eat it raw, and stop buying iodized salt to get your quota of iodine. Most of us say "No, thanks," to mouldy food, yet Roquefort cheese depends on Penecillium to give it the desired flavor. Few fungi, other than mushrooms, are eaten anywhere. Mosses and ferns likewise.

A visit last week to Chinatown netted a variety of unusual things, bean sprouts for chop suey, taku, a substitute for potatoes, water chestnuts, Chinese turnips, green tinted squashes with white flesh, Chinese nuts, ginger, both raw and preserved. Surely Hop Sing must find curious vegetables and fruits in American markets.

"Because people in Hawaii eat imported vegetables in preference to home grown varieties, the Hawaiian Agricultural Experiment Station has published a list of sixty-two Hawaiian vege-

*Read at the Biology Section of the Central Association of Science and Mathematics Teachers, Chicago, Nov. 26, 1926.

tables with notes on their food value and directions for cooking and serving them."

"Man shall not live by bread alone" so let's have some meat. Sea anemones, Actinia viridis and equina, are boiled or fried; while at a French feast of "Earthworms rolled in batter and put in an oven, where they acquired a delightful golden tint, and we are assured, a most appetizing smell * * * the fifty guests rose like one man and asked for more."

My Sicilian pupil, Paglino, one day remarked "We eat those" indicating sea urchins. "They are very delicious" and I learned that the "sea egg" is often gathered when ready to spawn. Sea cucumbers, Holothuria edulis, eviscerated and dried serve as a base for a gelatinous soup.

Swift said "He was a bold man who first ate an oyster"—now only the crank refrains, while mussel clams, scallops, whelks, limpets, abalone, periwinkles, vineyard snails, squid, cuttlefish and even the devil (fish) itself trails behind in a delicious procession.

"The man had sure a palate covered o'er
With steel or brass, that on the rocky shore
First ope'd the oozy oysters pearly coat,
And risked the living morsel down his throat."

All the world feasts on crustacea but most of us would hesitate to follow the custom of the native Hawaiians as did my Quaker friend, Robert Merideth in eating live shrimp. "You must pick it up by the head, which is hard to do, for it will hop about in the net at a lively rate; then with a cool head and a steady nerve you must open wide your mouth, and be sure its legs all enter; then while it is kicking with all its might you must bite it in two just behind the eyes. The delicious morsel dissolves in your mouth like a flash * * *. They taste something like an oyster only more tender and sweet."

We prefer to take our insects a la honey but Dr. William McGovern, in the Amazon jungle, learned to enjoy caterpillars and ants, the roasted kings and queens of the leaf cutting ants reminding him of crisp bacon.

Locusts are common in the Manilla markets. Did John the Baptist eat insects or the "St. John's Bread" which is the dried pod of a locust tree? "Hoppers" are not commonly eaten in Palestine, but in Arabia—"The natives dismember the insects, pulling off the legs and wings, but not the head, and while still alive, roast them in a pan over the fire, and after being thorough-

ly dried in the sun, they can be stored away in sacks. The taste is said by them to be akin to that of fish."

Chowder or soup is made from the heads of trout and other fish, thus utilizing a possible waste product of our markets.

Sharks fins and dried swim bladders of fishes are staple Chinese products; in fact I found a variety of strange dried fish in Chinatown markets.

Wm. Beebe found the huge tortoises of the Galapagos, almost exterminated, due to sailing vessels loading them into the holds where they lived for months without food or water, ready to be served on demand.

Turtle eggs of course are much sought after. Roosevelt, in Africa, breakfasted on scrambled crocidile eggs and Reese served alligator, by agreement, to a group of Arkansas students. The iguana of tropical America has paid the penalty of being as delicious inside as it is ugly outside.

I have not been able to verify a snake dinner, though I have a hazy recollection of reading of such a banquet served by a Buffalo saloonkeeper to some old topers years ago.

Eggs of all sorts and styles are served in hundreds of ways, so I shall content myself with the Chinese delicacy "Pidan" Duck eggs are coated with a paste made of tea, lime, salt and wood ashes, packed in rice hulks for months or years and eaten raw as a relish.

Dr. William McGovern essayed to eat stewed parrot but poll was a tough bird and though boiled, baked and reboiled, it proved too tough for him.

I fried and tried whale once and have been notified not to do it again, yet whale flesh is a popular article in Japan and among the Eskimos.

The manatee is said to have much the character and flavor of pork.

A list of mammals eaten would be only a catalogue of species ranging from 'possum and armadillo to monkeys, all having their enthusiastic advocates. Walrus steaks, elephant toes, pigs ears, lamb frys, kangaroo tails and porcupines. Really! nothing is curious about what one eats, if you are accustomed to it.

Among the Igorots of the Philippines "Dogs are a highly appreciated article of diet and are brought in large numbers to Baguio for sale." The choicest method of serving is riced dog. The candidate is starved until ravenously hungry, then gorged

with cooked rice, after which both dog and rice may be baked together.

George Kennan was feasted in Northern Siberia by the patriarchal Koraks who had a tribal banquet in his honor. The stew was excellent and he was prompted to inquire into its composition. A reindeer had been slaughtered and into the pot went its blood, the lichen contents of its stomach, suet and flesh.

Mary Hastings Bradley tops this dish of the arctic with one from the Sahara served her by an Arab. "A huge tray had been brought in with mounds of rice and mutton in gravy about the edge; the center was filled with strange things that gave me pause, little soft things like stewed oysters. But they were *not* oysters; they were—as I unhappily recognized the moment after confronting them—they were sheep's eyes. . . . I tried to hope they were for garnishment, I tried to hope that one ate them last, after the host had left us to seclusion. I wondered desperately, if one downed them smothered in rice—and then the host leaned forward, selected the plumpest pair with his fingers, dipped them in the gravy and with firm and formal courtesy put them in my mouth. It was the perfect ceremony of hospitality."

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LABORATORY EXPERIMENTS IN PHYSICS REQUIRED IN THE NINE DETROIT HIGH SCHOOLS.

BY HAZEN S. SLACK, *Eastern High School, Detroit*,

AND

FRANCIS D. CURTIS, *University of Michigan*

PROBLEM

The purpose of this investigation is to ascertain (1) what experiments in physics constitute the required list of laboratory experiments in each of the nine Detroit high schools, and (2) what experiments in physics are required in all of these high schools.

METHOD

A list containing all of the experiments in physics required in the Eastern High School, Detroit, was sent to the head of the department of physics in each of the other eight Detroit high schools. Each department head was requested to check on this list every experiment which he ordinarily required as part of the laboratory work in physics in his school, and to write at the end of the list the titles of all other experiments which he required but which did not appear in the list. Space was provided below the list in which to write the name of the manual used and the number of laboratory and recitation periods per week devoted to physics.

FINDINGS

1. Four of the Detroit high schools use Adam's manual[1], four others take their experiments mainly from the Adams manual, while the other uses its own laboratory syllabus.

LIST OF LABORATORY EXPERIMENTS IN PHYSICS REQUIRED IN ALL OF THE NINE DETROIT HIGH SCHOOLS

Mechanics:

1. Measurements—with meter stick.
2. Measurements—with vernier calipers.[2]
3. Density and specific gravity of solids by measurements.
4. Buoyancy: symmetrical solids heavier and lighter than water (volume determined by measurements and displacement).
5. Buoyancy: irregular solids.
6. Concurrent forces.
7. Parallel forces.
8. Pendulum—laws.
9. Inclined plane.[2]

Sound:

1. Lengths and tensions of vibrating strings.

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[1]Charles F. Adams, *New Physics Laboratory Manual*, American Book Co., 1909.

[2]In school C, these experiments are required of only the more able pupils.

Light:
1. Convex lenses—focal lengths and images.
2. Index of refraction of glass.

Heat:
1. Specific heat of various metals and solids.
2. Heat of fusion.
3. Heat of vaporization.[2]
4. Coefficient of linear expansion of metals.[2]

Magnetism:
1. Magnetic field and poles (blue print).
2. Laws of magnetic attraction and repulsion.

2. Seven periods per week are devoted to physics in the Detroit high schools: three for laboratory and four for recitation.

3. Only fourteen experiments in physics are common to the required lists of all the nine Detroit high schools. These experiments are distributed as follows: seven in Mechanics, one in Sound, two in Light, two in Heat, and two in Magnetism.

4. Fifty experiments are common to the required lists of five or more of the nine high schools: eighteen in Mechanics, three in Sound, six in Light, nine in Heat, two in Magnetism, and twelve in Electricity.

5. Table III shows that there is little uniformity among these nine high schools with respect either to the total number of required experiments or to the number of required experiments per division of physics.

TABLE I. LIST OF LABORATORY EXPERIMENTS IN PHYSICS REQUIRED IN FROM FIVE TO EIGHT OF THE NINE DETROIT HIGH SCHOOLS

Title of Experiment[3]	School								
	A	B	C	D	E	F	G	H	I
Mechanics:									
1. Measurements—with micrometer calipers	x		x	x	x	x	x	x	x
2. Boyle's law	x	x	x	x	x		x	x	x
3. Buoyancy—determination of density of liquids		x	0[4]	x	x	x	x	x	x
4. Acceleration on inclined plane	x	x		x	x		x	x	x
5. Hooke's law (with spring)	x	x	x	x		x	x	x	
6. Pendulum—determination of g		x		x	x	x	x	x	x
7. Pulleys	x	x			x	0	x	x	x
8. Center of gravity of meter stick by principle of moments	x	x				x	x	x	
9. Wheel and axle	x	x			x	0		x	
Sound:									
1. Velocity, by resonance in tubes	x	x	x	x	x	x	x	x	
2. Siren		x		x	x		x	x	
Light:									
1. Photometry		x	x	x	x	x	x	x	x
2. Plane mirror—laws of reflection and images	x	x		x	x	x	x	x	x
3. Concave mirror—focal length and images	x	x		x	x	x	x	x	x
4. Index of refraction of water		x	0	x	x	x	x	x	x

	A	B	C	D	E	F	G	H	I
Heat:									
1. Thermometer—fixed points	x	x		x	x	x	x	x	x
2. Thermometer—calibration (graph)		x		x	x		x	x	x
3. Cooling through change of state		x		x		x	x	x	x
4. Determination of water equivalent		x		x		x	x	x	
5. Mechanical equivalent of the calorie		x		x	x		x	x	
Electricity:									
1. Electromagnet—testing polarity		x	x		x	x	x	x	x
2. Wheatstone bridge	x	x	x	x	x	x	x	x	
3. Resistance — voltmeter- ammeter method	0	x	x	x	x	x	x	x	
4. Electromagnet—its construction		x	x		x	x	x	x	x
5. Electromagnet—effect of introducing core in helix		x	x		x	x	x	x	x
6. Primary cells—electromotive series	x	x	x		x		x	x	x
7. Induction—magnets and coils	x	x	x	x	x		x	x	
8. Resistance—substitution method.	0	x		x	x	x	x	x	
9. Connecting up electric bell and telegraph	0	x			x	x	x	x	
10. Primary cells—kinds of electrolytes		x			x	x	x	x	
11. Electroplating		x			x		x	x	x
12. Heat equivalent of electric current 1 joule = .24 calorie		x		x		x	x	x	

[3]For convenient reference, in this and the following table the experiments are arranged under each of the main divisions of physics in the order of the number of schools in which the respective experiments are required.

[4]0 indicates that the experiment is required of only the more able pupils.

TABLE II. LIST OF LABORATORY EXPERIMENTS IN PHYSICS REQUIRED IN FEWER THAN FIVE OF THE NINE DETROIT HIGH SCHOOLS

Title of Experiment	School A	B	C	D	E	F	G	H	I
Mechanics:									
1. Specific gravity—balancing columns		x	x				x	x	
2. Acceleration—Packard apparatus		x		x	x			x	
3. Open-arm manometer—lung pressure	x	x					x	x	
4. Open-arm manometer—gas pressure		x					x	x	
5. Open-arm manometer — water pressure at tap		x					x	x	
6. Centrifugal force		x		x			x		
7. Screw		x						x	x
8. Power—H. P. of a motor		x						x	x
9. Pressure beneath surface of a liquid	x							x	x
10. Power—K. W. of a motor		x					x		
11. Worm-gear		x						x	
12. Plotting and interpreting of graphs			x						x
13. Manipulation and care of beam balance		x	x						
14. Application of Boyle's law—checking water pressure computation with water gauge		x							x
15. Crane									x
16. Barometer—correction for temperature and altitude									x
17. Train of gears		x							
18. Levers		x							

Title of Experiment	School								
	A	B	C	D	E	F	G	H	I
19. Jolly balance			x						
20. Use of protractor				x					
21. Surface tension (qualitative)				x					
22. Capillary action				x					
23. Prince Ruppert's drops				x					
24. Pressure and total force on sheet of paper				x					
25. Height of building with aneroid barometer				x					
25. Osmosis						x			
Sound:									
1. Velocity of sound in metals—Kundt apparatus		x		x				x	
2. Overtones in open and closed organ pipes		x					x	x	
3. Modulator—made by class from wood or cardboard		x						x	
4. Scale ratios		x							
5. Frequency of a fork		x							
Light:									
1. Critical angle of a prism		x			x	x	x		
2. Wave length—manometric flame and grating—sodium		x				x		x	x
3. Wave length—lithium		x				x		x	
4. Magnifying power and resolving power of eye—use of chart		x					x		
5. Polarization			x						
6. Concave lens and concave mirror—images				x					
7. Construction of telescope, compound microscope, and opera glass				x					
Heat:									
1. Dew point			x			x			x
Magnetism:									
1. Magnetic distribution in slender rod by magnetoscope				x					
Electricity:									
1. Use of galvanometer and shunt		x			x	x	x		
2. Construction of test-tube storage battery		x			x		x	x	
3. Testing efficiency of electric water heater				x				x	x
4. E. M. F. by potentiometer		x		x				x	
5. Simple 4-cell rectifier		x					x	x	
6. Measuring input and output of storage battery		x					x	x	
7. Radio transmitting set		x			x	x			
8. Radio receiving set		x			x				
9. Computing cost of electric heating									x
10. Electrotyping									x
11. Voltage of cells in series and parallel	x								
12. E. M. F. by condenser method		x							
13. Wattage and expense of using certain practical A. C. appliances						x			x
14. Ohm's law			0						
15. Resistances of cells			0						
16. Telephone	0								

TABLE III. SUMMARY OF THE NUMBERS OF LABORATORY EXPERIMENTS IN EACH OF THE SIX PRINCIPAL DIVISIONS OF PHYSICS, REQUIRED IN THE NINE DETROIT HIGH SCHOOLS

Division of Physics	School									
	A	B	C	D	E	F	G	H	I	Average
Mechanics	16	29	14	21	15	13	21	25	20	19.3
Sound	2	8	2	4	3	2	4	6	1	3.6
Light	4	10	4	8	7	9	8	8	7	7.2
Heat	3	7	3	7	5	6	7	7	6	5.7
Magnetism	2	2	2	3	2	2	2	2	2	2.1
Electricity	4	20	7	7	15	12	16	17	9	11.9
Totals	31	76	32	50	47	44	58	65	45	49.8

SUN SPEAKS TO EARTH.

The sun and the earth will speak to man and man will understand; the meaning of the messages from the sun that man, in his displeased ignorance, calls static and fading, will be deciphered. These predictions were made by Dr. Michael I. Pupin in his address as retiring president of the American Association for the Advancement of Science at Philadelphia, Dec. 27.

After recounting the half-century of progress in electrical communication that began with Bell's invention of the telephone, Dr. Pupin said:

"The next twenty-five years will not merely see men speaking to men all over the world. The earth itself, and the sun, that great center of all our terrestrial energy, which means all our life, will be speaking to men by means of electrical communications, and men will understand the message. They are speaking now, but as yet we do not understand. We call their voices 'static' 'fading,' 'earth currents' and other disagreeable terms. The means of electrical communication which the coming generation will develop will be also powerful instruments in their hands for the study of the electrical activity of our solar system; that study will decipher the messages which we now do not understand."

"I myself have already watched on my instruments the arrivals of these cosmic messages," Dr. Pupin continued. "The earth currents in transatlantic cables and the fading of radio messages, for instance, rise and fall, rise and fall, very very slowly, taking hours and hours to complete a cycle. It is like watching the deliberate and irresistible breathing of a cosmis giant. I can only guess that it means a constant, slow, rhythmic change in the electrical relations between the sun and earth. But where I can only speculate today, the next generation will know."

Shame at not being able to pronounce English as well as a simple steel disc in front of a magnet was a factor in Dr. Pupin's rise from sheep herding in Serbia to the heights of American science. For tonight, Dr. Pupin revealed that at the centennial exposition in 1876, he heard Bell's telephone demonstrated and decided to learn how it executed its magic performance that so far exceeded in perfection the articulation of his speaking organs accustomed to Serbian speech. Today the telephone repeater and telephone cable with inductance coils, thanks largely to Dr. Pupin, make New York, St. Louis and Chicego one large telephonic community. —*Science News-Letter.*

A trade school of masonry, stone-cutting, and reinforced concrete has been established in Paris which provides students with sleeping quarters at a franc a night and meals at 3½ francs each. Payment is made also for student labor. Testing laboratories, drafting rooms, machinery, and space for the practice of each trade are provided.

SOME ABSURDITIES IN THE USUAL DISCUSSION OF WORK AND POWER.

By William S. Franklin,
Massachusetts Institute of Technology.

Pascal, whose "principle" is badly messed up in nearly every physics text known to the writer, laid down a good rule for us to follow in our endeavor to recognize and understand the principles of physics. "Nothing," says Pascal, "is needed but good eye-sight, but it must be good, because principles are so minute."

Let us consider the mechanical principle of work with the help of Pascal's philosophy.

"A force does work when it moves a body." This statement certainly involves more than good eye-sight; what does it mean to say that a force moves a body? The reader may know what it means, but the writer certainly does not know except in a hopelessly vague way. Anyway, imagine a mouse and an elephant to be hitched up to a wagon as a team. The mouse does work because *the wagon moves in the direction in which the mouse pulls;* but is it not absurd to say that the mouse does work because *it moves the wagon?* This point of view shows scant respect to the elephant! No, the mechanical principle of work is correctly stated thus: a force does work when the body on which the force acts moves in the direction of the force, and anyone who has eyes can understand what this means. It makes no difference whatever as to what moves the body!

A string 10 feet long is tied to a post and a pull of 5 pounds is exerted on the post by pulling on the string. This force certainly "acts through a distance of 10 feet" because the string is 10 feet long, and "work is done when a force acts through a distance" so that 50 foot-pounds of work is done on the post! This argument has been found by test to be acceptable to about 60% of the men beginning a college course in mechanics! No, *work is done when a body on which a force acts moves in the direction of the force,* and no dictionary ever defined the word *through* in a way to justify the use of the word to abbreviate this 18-word statement of the mechanical principle of work as it is usually abbreviated in the study of physics in school and college. Language has been developed as a medium for dickering, quarreling, and love-making, and language as used in precise physical specifications is always more or less awkward and more or less strained; but it is a serious mistake to attempt to obviate these by using meaningless expressions and phrases.

A very great deal of the difficulty which young men have in correct application of the principles of physics comes from meaningless and ambiguous statements which young men accept as statements of principles. Years ago the writer gave a test problem to a group of engineering Freshmen who were nearly finished with their Freshman mechanics. A cart moves northwards at a speed of 2¾ feet per second. A mule exerts a northward pull of 50 pounds on the cart and a man exerts a downward push of 250 pounds on the cart. Required the rate at which the mule does work and the rate at which the man does work. Forty-five per cent of a large class found that the mule was doing ¼ horse power and the man 1¼ horse power! If the part of his body used by the man in pushing on the cart had been named in the statement of the problem no one would have entertained such an absurd result, and if the correct and clearly intelligible statement of the principle of work had been kept in mind every man in the class could easily have found the correct answers.

It is highly important to frame up statements of definitions and principles in physics as referring explicitly to actual physical things. Thus it is largely meaningless to say that "power is rate of doing work"; no, the power of an agent is the rate at which the agent does work. It is physically meaningless to say that "density is mass divided by volume"; the correct statement is that the density of a body is equal to the mass of the body divided by its volume. To say that a kilowatt-hour is the work done in one hour by a kilowatt is absurd; who ever saw a kilowatt, and how can a kilowatt do work? No, a kilowatt-hour is the amount of work done in one hour by an agent which does work at the rate of one kilowatt—and by agent we do not mean an insurance agent! Ask a student about the accelerating effect of a force and he is apt to make the following sounds in answer—*eff equals emm aye*, as if the naming of the letters in an equation could possibly pass as a physical statement!

Expenditures for public education in Basel, Switzerland, a city which constitutes a canton in itself, were 10,636,610 francs in 1924, or about $2,000,000. The population is only 142,574, and the expense of education amounts to an annual tax of more than $14 upon every inhabitant of the city.—Calvin M. Hitch, American Consul.

BALDWIN-WALLACE COLLEGE MATHEMATICAL PROGRAM.

Reported by Prof. Oscar L. Dustheimer,

Baldwin-Wallace College, Berea, Ohio.

The following Mathematics Program was given at Baldwin-Wallace College some time ago. Much interest was shown by the students in this unique chapel exercise. A part or all of this program may be of interest to teachers who are sponsoring high school mathematics clubs.

J. M. K.

The following questions will be considered:

Miss Gladys Bradley.

1. What part of one half square yard is one half yard square?
2. What three figures multiplied by 4 will make precisely 5?
3. Can you take 1 from 19 and get 20?
4. Which is correct to say, 5 and 6 are 12, or to say 5 and 6 is 12?
5. Which is the greater—3 solid inches or 3 inches solid?
6. Which weighs the more, a pound of feathers or a pound of gold?
7. How many 3 inch tile will it take to carry as much water as a 6 inch?
8. If a melon 20 inches in diameter is worth 20c, what is one thirty inches in diameter worth?
9. John found $10, what was his gain in %?
10. 3 plus $3\times3-3\div3-3$ equals what?
11. What is the difference between half a dozen dozen and six dozen dozen?
12. If the third of six be three, what must the fourth of twenty be?
13. Thrice naught is naught, what is the third of infinity?
14. What is the difference between twice 25 and twice 5 and 20?
15. When is a number divisible by 9?
16. If you cut thirty yards of cloth into 1 yard pieces, and cut 1 yard every day, how long will it take?
17. Can you write 30 with three equal figures?
18. Can you write 24 with three equal figures, neither of them being 8?

Mr. Sidney Walk.

19. To prove that $-1=1$.
20. At 4%, what would be the amount due last Christmas on $1 put at interest at the beginning of the Christian Era, to be compounded annually?
21. What would be the interest due on $1 for the same time and rate but at simple interest?

22. To prove that 2=1.
23. To prove that you are as old as Methuselah?
24. Arrange the figures 1 to 9 inclusive so their sum will be 100.
25. Express the number 10 by using five nines.
26. Do figures ever lie?
27. A ball falls fifteen feet and bounces back 5 feet. How far will it bound before it comes to rest?
28. Arrange the figures 1 to 9 inclusive, in a magic square so as to count 15 in every straight line.
29. If 6 cats eat 6 rats in 6 minutes, how many cats will it take to eat 100 rats in 100 minutes?
30. To how many decimal places has Pi been worked out?

AERONAUTICAL EDUCATION IN AMERICAN UNIVERSITIES.

There are today five universities in the United States with personnel, laboratories and equipment sufficient for the complete training of aeronautical engineers in both undergraduate and graduate work. During the past year these five institutions had 96 students under instruction in regular aeronautical engineering curricula. These figures are taken from reports received from colleges and universities throughout the country in answer to a questionnaire distributed by the Daniel Guggenheim Fund for the promotion of aeronautics.

The reports received from the questionnaire indicated that 23 institutions in the country are giving some attention to aeronautical subjects, but the greater number of these have no particular equipment or staff to give serious attention to aeronautical engineering education. How ever, in addition to the 5 institutions equipped for complete aeronautical training there are 4 others which have established either chairs or departments of aeronautics and which are offering elective subjects in aeronautics to engineering students.

The questionnaire was distributed to more than 500 institutions. A recapitulation of the answers received follows:

Number of institutions giving instruction of some kind in aeronautics	23
Number of institutions having school or department of aeronautical engineering or chair of aeronautics	9
Number having aeronautical laboratory or equipment to conduct aeronautical tests or research	14
Number offering graduate courses in aeronautical engineering	10
Number offering fellowships to graduate students in aeronautical engineering	7
Number offering a course in aeronautical engineering leading to a degree	5
Number providing elective subjects in aeronautical engineering to students taking regular engineering course	21
Number carrying on organized research in the field of aeronautics	8
Number of undergraduates taking regular aeronautical engineering curricula leading to a degree	96
Number of undergraduates taking regular engineering curricula electing certain subjects in aeronautics	163
Number of graduate students taking courses in aeronautical engineering	26

AN EVALUATION OF A REORGANIZATION OF THE PRESENT CORE OF SUBJECT MATTER IN HIGH SCHOOL PHYSICS.

By Chester J. Peters,

Supervisor of Science, University High School, Columbia, Mo.

During the past ten years much dissatisfaction has been expressed regarding the present organization of our high school physics course. It is admitted by many of the high school teachers of the subject that the course as it is now organized does not meet the present needs of the high school pupils.

That the physics course has not kept pace with the high school development is well shown by the following table:

Table I—Growth of High Schools Since 1890 and the Per Cent of Pupils Taking Physics During that Period.

Date	Number of high schools[1]	Per cent of Pupils taking Physics[2]
1890	2,500	22.2
1895	4,000	22.7
1900	6,000	19.0
1905	7,500	15.6
1910	10,000	14.6
1915	12,000	14.2
1920	14,000	....
1922	....	8.9

Table reads: In 1890 there were 2,500 high schools in the United States with 22.2 per cent of the pupils taking physics, etc.

It appears that the physics course has not retained the popularity enjoyed in 1890. From the history of the methods of physics in the high school, one would be led to believe that the subject gained in popularity until about 1895 and from these data it would seem evident that the popularity has been on the decline since that time. In Missouri[3] the enrollment in physics for the year 1914-15 was 9.7 per cent of the total enrollment of the high schools. For the year 1924-25 the enrollment in physics was 7.3 per cent of all the pupils in the high schools. This indicates a decrease of 2.4 per cent of the pupils taking physics compared with the total number enrolled in the high schools of this state over a ten year period.

There is much disagreement regarding the type of organization of subject matter which is best suited for the instruction of high school pupils. This has been a matter of controversy for many years.

[1]Bulletin No. 19 (1920), Bureau of Education, Washington, D. C., pp. 11-12.
[2]Biennial Survey of Education, Vol. No. 2, 1920-22, p. 578.
[3]Bulletin No. 1, State of Missouri, Course of Study, Department of Education, 1925, p. 31.

It appears from a summation of the arguments in the literature during the past twenty years that many of the most competent physics teachers are firm in their stand that the primary emphasis should be placed on the fundamental principle; that the fundamental principle should come first, then such applications as illustrate this principle be brought in later. They argue that the applications will be made by the pupil whenever necessary if he is well grounded in the fundamentals. It is held that the fundamentals are the most important consideration of the course and that a knowledge of them is obtained only by hard, continuous, and ardent labor on the part of the pupil. The desired result sought for is mental power. Applications are held to be secondary because with an adequate knowledge of the fundamental principles these applications to the things of every day life are readily made by the pupils themselves.

In opposition to this point of view, there are those who believe physics should be more closely correlated with the everyday experiences of the pupils.

From a summation of these arguments it would appear that the most effective, as well as the most interesting, way to get high school boys or girls to comprehend the full significance of a physical law or principle is to study its applications, selecting those with which they are more or less familiar. That is to say the emphasis is now being misplaced in the teaching of high school physics, and that it should be placed more largely upon applications and less upon pure science.

The conditions of modern life, on account of the many and recent inventions such as the radio, the vacuum sweeper, the telephone, etc., are such that the public demands that science be taught. Unless the modern boy or girl has a true conception of the fundamental principles as applied to the common devices they use, they are not in the present meaning of the term, educated in these matters.

Current periodicals[4] are giving increased space to the discussion of scientific topics of a practical nature. The popularity of the general science courses over that of physics would lead one to believe that there is something wrong with the present day teaching of physics. Obviously it is not with the subject matter itself, for that deals with the very things that people are vitally interested in.

[4]Fansler, P. E. "Heating the American Home," Good Housekeeping, Feb., 1926, p. 80; March, 1926, p. 88.

It is a well known fact that in the organization of the typical textbook of high school physics the fundamental principle or law is first stated and then such applications are mentioned as pertain to that principle or law as there is space for.

It was found[5] in the state of Missouri in 1925-26 that 90 per cent of the teachers of physics reporting to a questionnaire sent out by the writer follow the exact organization of the large divisions of subject matter as they appear in the textbook used. It was also found[6] that of these teachers 96.5 per cent followed the exact sequence of these large divisions through the book they used.

In view of the conflicting opinions mentioned above and with a knowledge of current practice in physics teaching in the high schools of this state an attempt at an evaluation of a reorganization of the present core of subject matter in high school physics has been made at University High School in the past two years. The problem involved two types of organization, with their accompanying methods which will be described later. The two types of organizations are: (1) the organization of the typical textbook in which the fundamental principle or generalization is stated and then applications given to clarify or illustrate that principle; and, (2) a type of organization which gives first emphasis to the application of the fundamental principle and later states the generalization or law.

The project began in the winter semester 1924-25 and extended over two semesters. Three other high schools cooperated in working out the data. They were: Columbia High School, Hannibal High School, and Palmyra High School.

For convenience in applying the experimental factors, the semesters during which the investigation was in progress were divided into periods of three weeks each. McCall's[7] "Rotation Method," with one group and two experimental factors, was used. Two initial tests were given at the beginning of each experimental period and two final tests were given at the end. One of the two tests was designed to test the increase of information relating to the fundamental principle while the other was constructed to test the increase in knowledge of principles as related to the application.

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[5]Peters, Chester J., Master's Thesis, University of Missouri, 1926, p. 7.
[6]Peters, Chester J., Master's Thesis, University of Missouri, 1926, p. 7.
[7]McCall, William A., "How to Experiment in Education," p. 19.

The method used in this investigation is designated by McCall[8] as the "One Group Method." The one group under observation was the class being taught. There were two experimental factors, hereafter designated by (EF), involved. These were: (1) the organization of the typical textbook of high school physics, and (2) a reorganization of the subject matter giving first emphasis to the application rather than to the fundamental principle. The former is designated as (EF_a) while the latter is represented by (EF_b). These were applied in rotation during the semester in experimental periods of three weeks each with a few exceptions in the length of the periods noted later. The effectiveness of each of these EF's was determined by two tests; one based exclusively on fundamentals, and the other on applications. Therefore, the whole process could be termed the one group method with two experimental factors and two types of tests.

The following plan was used:

(IT_{1a} -- EF_{1a} -- FT_{1a} -- C_{1a}) -- (IT_{2a} -- EF_{2b} -- FT_{2a} -- C_{2a}) etc. (IT_{1b} -- EF_{1a} -- FT_{1b} -- C_{1b}) -- (IT_{2b} -- EF_{2b} -- FT_{2b} -- C_{2b}) etc.

IT_a = Initial test on fundamentals.

IT_b = Initial test on applications.

EF_a = Organization of the typical textbook.

EF_b = Reorganized material.

FT_a = Final test on fundamentals.

FT_b = Final test on applications.

The following symbols, although not used here, are explained at this time for convenience:

c_a = change in fundamentals during the application of EF.

c_b = change in applications during the application of EF.

C_a = average change for the class in fundamentals during the application of EF.

C_b = average change for the class in applications during the application of EF.

S = Subject.

At the beginning of each period an IT_a and an IT_b were given and the scores for each pupil recorded individually. Then the EF_a or the EF_b was applied. These were alternated throughout the semester during which the experiment was being carried on.

[8] McCall, William A., "How to Experiment in Education," p. 19.

Only one experimental factor, however, was applied during any given experimental period. These periods were, in most instances, three weeks in length. At the end of each experimental period FT_a and FT_b were given and the scores for each student recorded individually. It is quite evident that the difference between IT_a and FT_a will be the change due to the EF_a and this is designated as C_{1a}. Likewise the difference between IT_b and FT_b will be the change due to EF_b and will be designated as C_{1b} for the first period. The numeral subscript represents the period under consideration.

Therefore it is quite obvious that $C_{1a}+C_{3a}+C_{5a}$ and $C_{1b}+C_{3b}+C_{5b}$ would be the total change due to the application of EF_b assuming that EF_b was applied during the uneven periods. Likewise $C_{2a}+C_{4a}+C_{6a}$ and $C_{2b}+C_{4b}+C_{6b}$ would be the total change due to EF_a assuming that EF_a was applied during the even periods.

It may be noted that no effort is made to compare scores between the test of fundamentals and that of the applications, i. e., C_{1a} and C_{1b}, because it is not known that a unit in fundamentals is comparable with a unit in applications. Therefore, it is noted that all comparisons are made between $C_{1a} - - C_{2a} - - C_{3a}$ etc., and between $C_{1b} - - C_{2b} - - C_{3b} - -$ etc.

It should be noted again that no attempt can be made, with these data, to compare the relative marks of the various schools cooperating. This is obviously due to the fact that there are many irrelevant factors such as relative I Q's of the pupils, types of organization used at corresponding times in the various schools equipment, and many others which cannot be eliminated when attempting to compare the various schools.

Each test, both in types A and B, was composed of ten questions. Each test was scored on the basis of a possible total range of one hundred points. These scores are comparable to per cents and may be so termed if the reader desires. The questions in tests "A" were chosen from the fundamental principles of the textbook in use by the class. Those in tests "B" were made up of the applications of these fundamental principles either listed in the textbook or in the experiences of most of the pupils of this community. The questions were of the completion type or of the multiple choice type. Since each test was made up of ten questions, each question was given an arbitrary value of ten points. In case a question was composed of two parts, (a) and (b), each part was given an equal rating of five points.

Therefore, the scores shown in the following table are the raw scores based on the range just given, and are comparable to per cents of the same numeral value.

The following procedure is that used in School I with the organization of the textbook (Experimental factor "A"). It could hardly be said that the procedure of all four schools with four different teachers was identical but in the main the procedure with each type of organization was very similar, but the type of organization was the same.

The assignments made were based on the organization of the textbook. A definite number of pages or sections were assigned to be prepared for each recitation period. Problems which appeared in the textbook were given to accompany the material of the assignment. The class period, for the most part, was spent discussing principles from the textbook with any applications which might appear in the textbook. The principles were discussed first, as in the textbook, then the applications were discussed. Pupils were asked individual questions regarding the explanation of principles in the assignment. If the pupil called upon was unable to answer, the question was passed to another, a volunteer, if there was one. When the pupil had finished, contributions from other pupils were accepted. A summary was usually given by the teacher. In case no pupil was able to successfully discuss the principle asked for the teacher usually gave a brief explanation of the same, followed by instructions for future study on the part of the class, and the question was reconsidered in the next physics recitation.

Some of the time of each class period was spent discussing assigned problems which proved difficult for the various members of the class. At the close of the period the assignment for the next recitation period was made. The recitation periods were forty-five minutes in length. Three recitations were observed each week. Two double periods each week were devoted to laboratory work.

In the laboratory the pupils were divided into groups of two to four members. They were assigned experiments from laboratory manuals which related directly to the work in the textbook. Whenever equipment was available all the pupils worked on the same experiment but the lack ot sufficient sets of apparatus at times prevented this. In that case more than a single experiment was under way at one time. If available, the exact laboratory manual of the textbook was used. The experiments chosen

were those which exemplified the laws which were being studied in the recitation. They were, for example, of the following type: Boyle's Law, Linear Coefficient of Heat, Heat of Condensation of Steam, Law of Refraction of Light Through Glass, Plotting a Magnetic Field, Ohm's Law, and Law of Resonance.

When each pupil had finished his experiment according to the instructions in the manual, he was required to make a written report in a notebook according to the following form:

Object:
Apparatus:
Data:
Computations:
Diagrams:
Description:
Conclusion:

Each pupil did all his work in the laboratory under the supervision of the teacher in charge.

The second experimental factor (experimental factor "B") was a reorganization of the material found in the ordinary textbook and is based on fundamental principles compiled in the thesis of Herriott.[9] It would be unsafe to state that the cooperaing teachers used exactly the same methods but, in the main, the procedure was very similar and the type of organization the same. The procedure, for the most part, which accompanied this organization is described below.

The class room work took the nature of a discussion which centered itself around some application or applications of the central core of subject matter being studied in class. The application was always one which was familiar to most of the pupils in the class, i. e., the refrigerator, in the study of heat. Not all of the phases of a common application were necessarily studied at one time. For example, the use of the partial vacuum and how it is produced by the vacuum cleaner would be studied in connection with mechanics of gases while the motor would be studied in connection with motors in electricity. Thus the large organizations of the textbook were preserved. This fact may be considered to be of material advantage to young teachers with our present textbook arrangement.

No single textbook was used. All available books, pamphlets, magazines, and charts were utilized in obtaining information regarding the thing studied. Information from any authentic

[9]Herriott, M. E., Master's Thesis, University of Missouri, 1924.

source was welcomed.

The discussion was led by a committee of pupils whose duty it was to be prepared on a particular phase of the total information. This was usually found in a book, pamphlet, or magazine, the reference to which was usually furnished by the teacher. The adopted textbook was used freely as a reference because it was always available. To insure a complete and full discussion, more than one pupil was assigned to the part of gathering information about a single phase of the subject being discussed. To cover the subject thoroughly several committees were formed to seek information about various phases of the application of the principle involved.

The discussion was usually led by the pupils of each committee in turn. Questions were asked by the teacher to bring out fully the relation between the application being studied and the fundamental principle of physics. In case there were many small things relating to the principle, such as the wheel barrow handle, the handle of the kitchen pump, the oar of a boat, the muscle attachments of the forearm, all of which relate to levers; they were first classified according to the fundamental principle of moments. Then numerous other applications of each classification were listed from the pupil's own experience.

The laboratory work was conducted in a manner that would bring it as near to the experiences and problems of the pupils as possible, and at the same time relate to the central core of subject matter being studied. The experiments were, for the most part, of the following type:

1. To study the pull of the hooks of a hammock which contained a one hundred fifty pound person.

This was done by stretching a wire between two large spring scales on hooks at a convenient angle (about that of the ordinary hammock.) The angles were measured and drawn to scale. By use of graphical representation of forces the problem was solved.

2. To study the principle of the fireless cooker.

This was done by recording the temperature for various pressures and plotting. The relation between the pressure and the boiling point is well demonstrated.

A list of possible experiments relating to the central core of subject matter was posted at the beginning of each period. Each pupil was permitted to choose the experiment which fitted his own case best.

Once an experiment was chosen, it was carried to completion, if possible, before another was begun by the pupil. After the experiment had been finished a written report was made on 4" x 6" cards, or in a notebook. These cards contained the following information:

Purpose of experiment:
Materials used:
Diagram of apparatus:
Data:
Description of procedure:
Results:

The following table gives the summation scores for the various schools in which the experiment was conducted. These scores represent the avearge of the scores over the whole of the time that the experiment was conducted in the school named.

TABLE II[10]—THE TOTAL CHANGE DUE TO EXPERIMENTAL FACTOR "A" AND TO EXIERIMENTAL FACTOR "B" IN EACH SCHOOL.

School	Experimental Factor "A"		Experimental Factor "B"	
	Test "A" Scores	Test "B" Scores	Test "A" Scores	Test "B" Scores
I (1924-25)	67.2	46.6	73.4	72.9
I (1925-26)	46.3	51.8	63.8	70.9
II (1924-25)	67.3	60.4	84.6	88.1
II (1925-26)	66.8	60.8	79.1	72.1
III (1924-25)	58.7	56.7	64.7	57.2
IV (1925-26)	56.6	40.3	65.6	68.3
Total	362.1	316.6	431.2	429.5

Table reads: In the experiment in School I (1924-25) the average change of the class in fundamentals when taught by the organization of the textbook is 67.2 of a possible 100, and the average change in application of these fundamentals when taught by the same organization is 46.6 of a possible 100. The average change in fundamentals for the same school when taught by the reorganized material is 73.4 of a possible 100, and the average change in applications of these fundamentals when taught by the reorganized material is 72.9 of a possible 100.

It is observed here in all cases, except one, that the change in applications is exceedingly low when taught by the organization of the typical textbook, it is seen also that in every case the change in both fundamentals and applications is greater when taught by means of the reorganized material. The significant thing to note, however, is that the change in the knowledge of the fundamentals of physics as such, the result ordinarily desired

[10] Peters, Chester J., Master's Thesis, University of Missouri, 1926. P. 56.

and the thing usually tested for, is shown to be greater in every school when the instruction was conducted by the reorganized material.

In all, eleven different classes were observed over a total of 475 class periods. These classes comprised a total of 177 pupils. There were 132 boys and 45 girls; all were juniors and seniors in high school. The experiment extended over two semesters and was carried on in every large division of subject matter in high school physics. EF_a was applied a total of 15 times and EF_b a total of 14 times. The experiment was conducetd in four different first class high schools by four different teachers. Two of the teachers were experienced teachers of physics, one was an experienced teacher but was teaching physics for the first time, and one was teaching for the first time. The teachers conducting the experiment represented both sexes with varied grades of experience and training.

The experimental periods were, in most instances, three weeks in length. This seemed to form the natural dividing line with respect to the time spent on each division of the subject matter and also furnished a very convenient means of dividing the semester into equal parts.

The organization of three different textbooks was used in the course of the experiment at the various schools.

Conclusions.

It appears unnecessary to summarize all the facts brought out in this experimental study to give a clear idea of its results. On the basis of the data secured there are, however, some outstanding conclusions which should be pointed out for further emphasis. They are:

1. The total change of the class was in every case greater when the pupils were taught by the reorganized material than when taught by the organization of the textbook.

2. There was no falling off of the ability of the pupils to grasp the fundamental principles under the reorganized material. This was shown in every case by the fact that the change was actually greater in fundamentals when the class was taught by the reorganized material than when taught by the organization of the textbook.

3. The change in applications was lower during the periods when the class was taught by the organization of the textbook. Then change in applications was very marked during the periods

when the reorganized material was used. It is therefore concluded that the pupils do not get an idea of the applications as well as they should, when the typical textbook organization is used, or as well as they do when the reorganized material is used.

4. From these data it is further concluded that it is better from the standpoint of high school physics, to *begin* with the application and draw the fundamental principle or law as a generalization from the applications studied, rather than first to memorize the principle and then seek applications of that principle or law.

5. It is also concluded, from this study, that the organization of the typical textbook is not so well adapted to use in high school instructions in physics as a reorganization of the material giving emphasis to the application of the principles.

HYDROGEN BECOMES HELIUM.

The metal palladium has the power of effecting the transmutation of hydrogen into helium. This is indicated in experiments reported by Prof. F. Paneth and Dr. Peters of Berlin University.

Palladium is a rare and heavy metal, similar to platinum, and has in a spongy state the peculiar property of absorbing a thousand times its volume of hydrogen gas. The hydrogen when so condensed in the pores of the finely divided metal is in an unusually active condition, perhaps because the hydrogen, which ordinarily consists of atoms joined together ordinarily in pairs, is here broken up into separate atoms which then unite eagerly with atoms of other elements such as oxygen. This reaction is so quick that a tiny bit of palladium put into a mixture of hydrogen and oxygen will explode it and form water.

If the conclusions of Paneth and Peters are correct then the hydrogen atoms condensed by palladium have also the ability to unite with one another in groups of four, which constitutes the helium molecule. They passed a stream of hydrogen gas over palladium in the colloidal state in which form the maximum amount of surface is exposed, and after twelve hours of adsorption they detected the main lines of the helium spectrum. As longer time elapsed the lines increased in intensity. It would require an enormous length of time to produce a sufficient quantity of helium, to be isolated and analyzed, but by using an extremely delicate spectroscope the amount of helium formed artificially by this process was estimated to be from one to ten thousand millionths of a cubic centimeter.

The transformation of hydrogen into helium, if it can be accomplished, would theoretically involve a loss in weight of eight-tenths of one per cent. The matter so destroyed would be transformed into energy and pass off as rays of light and heat. Such an annihilation of energy would produce an enormous amount of heat. According to some modern astronomers the rays of the sun and stars originate in such decomposition of matter. In the Berlin experiments no evolution of energy was observed, either because the heat was too small to be noticed or because it passed off in the form of radiation of extremely short wave lengths, like the penetrating rays coming from the sky which have been studied by Kohlhoerster and Millikan.—*Science Service.*

REPORT OF THE COMMITTEE ON CHEMISTRY, ASSOCIATION OF SCIENCE TEACHERS OF THE MIDDLE STATES AND MARYLAND, NOV. 27, 1926.

The committee was appointed for the express purpose of suggesting a syllabus in which the number of required topics would be lessened to permit more thorough teaching of essential matters. Realizing that there was no immediate prospect that our outline would be put into force at once by any official body, we felt that we should be somewhat daring in suggesting changes. The intention, in other words, is not to ask anyone at once to follow our proposals, but rather to stimulate three very important activities which should precede official promulgation of syllabi: thinking, experimentation, and general discussion. Possibly there should be a continuing committee on the syllabus which shall receive results of such activities and incorporate them from time to time in an outline that is never static, but always living and growing.

Aside from deletions, we are proposing three important changes. Two of them have already gone into effect in the syllabus recently issued by the New York State Department of Education; these two are: the electrical constitution of the atom for use in explaining chemical action, valence, and the nature of elements; and suggestions that the habits of scientists be continously taught as the course progresses. Our additional change suggests that chemistry be taught in quite a new way—dynamically, not descriptively; that elements and their chief compounds be treated not separately after the manner of the encyclopedia, but in action, and in constant comparison with each other. The coming into our science of the theory of the electrical constitution of the atom makes this method not only easy, but extremely desirable. The pupil gains more and gains it more easily if he studies chlorine, oxygen and nitrogen in comparison with each other. It is understood, of course, that laboratory experiments of the present type, in which chlorine, oxygen, etc., are prepared and studied would continue, and that whatever is necessary in the way of drilled memorization of individual properties and peculiarities of these elements will be learned in the laboratory—the only place they are ever really *learned* in any case. Similarly oxidation and reduction are better understood if treated in one place (granted that this comes after considerable experience with chemical action has already been obtained) than if given bit by bit, haphazardly, and never completely in a dozen different places. The principle we are suggesting is simply that of using generalization—the goal of science. The syllabus itself shows groupings by which the idea might be applied. It is believed that a further advantage will be gained—that of avoiding unfruitful repetition, as, for example, in the treatment of the reduction of the ores of metals.

We have made numerous small omissions; in addition to the following important topics which are found in the older syllabi: correction of gas volumes, law of multiple proportions, proof of the diatomic molecule of hydrogen, specific mention of physical properties of gases, vapor densities, calculation of molecular weights and formulas from vapor densities, the oxides of nitrogen (except incidentally as in the fixation of nitrogen), all technological detail such as construction of tanks, furnaces and the like; general, drastic reduction in metals. But it should be borne in mind that even were the syllabus to go into actual use at once, *it is presented as a minimum syllabus: anyone may add as much as his time permits.* The aim of the committee is to formulate and express through this organization two beliefs that are now very commonly held—that we should teach better what we do teach, and that all examination boards

should be restricted to a more limited content in preparing their questions.

The new New York State syllabus, to which reference is made in several places in the report, can be secured by applying to the State Department of Education, Albany, N. Y.

Scientific Objectives.

The constant and persistent attempts of late to revise science syllabi are largely the outcome of some searching questions which science teachers and science thinkers have been asking themselves. As compared to the bewildering achievements in the physical sciences, the social sciences seem to be at a standstill. It is not enough to say that in the physical sciences definite advances are constantly being made due to the ease with which decisive experiments can be made and carried out. We are apt to overlook, for one thing, that the alchemists were forever experimenting, with results that were astonishingly meager. We are only now beginning to comprehend, slowly but surely, that the achievements of modern science are in large measure due to the growth of a certain attitude of mind towards scientific problems. An understanding of this attitude of mind, the "scientific attitude," is of momentous concern to our civilization, for we science teachers and other thinkers are convinced that in the application of the scientific attitude to social problems lies the salvation of the race.

The scientific attitude of mind develops a disregard for opinions based on the emotions and prejudices of mankind, and craves careful observation, measurement and statement, together with a full, free publication, criticism, and discussion as means of freeing our race from the evil results of false seeings and believings.

If the outstanding achievement of modern science is to show how a certain attitude of mind can revolutionize a field of knowledge, and this in turn a world of life, how utterly preposterous does it become for teachers of science to continue teaching isolated and disconnected facts of science—laws of pulleys, the physical and chemical properties of gasses, for example—without attempting to inculcate scientific habits of mind in our pupils. *Fact gathering, to be sure, is not to be neglected,* but, on the contrary, to be used insofar as such facts are necessary as stepping stones to generalizations of value in our everyday life.

From our point of view, then, the scientific habit of mind should be the chief objective in the study of physical sciences. The scientific habits include *(a)* careful experimentation; *(b)* modification of accepted views as the result of new discoveries; *(c)* abandonment of the argumentative attitude and a desire to *win* for the scientific attitude and a desire *to get at the truth; (d)* the wisdom of full and free publication and the folly of secrecy; *(e)* the wholesomeness of constructive criticism; *(f)* belief in the universal operation of law; *(g)* the incompleteness of knowledge: *knowledge is a living, not a dead thing.*

If we have stressed so much this scientific attitude of mind, it is only because so far it has been practically ignored, and because of its tremendous social import. The sciences have, of course, other educational values, such as the acquisition of useful information, the acquisition of facility in the use of facts, the development of taste and power of appreciation, and habits of neatness; but these have been stressed in the past.

Chemistry Syllabus.

I. *Earth, air, fire and water.* The world around us. Matter as viewed by the ancients.

II. Earth. **Origin. Brief geological outline. Composition. Definition of an element.**

III. Air.

a. Origin. Brief geological outline.

b. Early notions concerning fire and air.

c. Composition.

1. Lavoisier's experiment to show oxygen in air.
2. Iron rust experiment to show nitrogen in air.
3. Brief mention of argon (see supplement of New York State Syllabus).
4. Water vapor.
5. Carbon dioxide.
6. Dust and bacteria.

d. Relation of air to life.

IV. Fire.

a. Burning; phlogiston; modern theory; Lavoisier's experiment.

b. Oxygen and oxides.

1. Decomposition of a chlorate mixed with a catalyzer.
2. Properties of oxygen including formation of oxides; oxidation in the narrow sense.

V. Water.

a Ice, water, steam; water as solvent; purification of water.

b. Electrolysis of water to show that it consists of oxygen and hydrogen; chemical change.

c. Preparation of hydrogen by action of sodium on water; zinc on dilute sulfuric acid; sodium hydroxide as an example of a base; sulfuric acid example of an acid; zinc sulfate example of a salt.

d. Properties of hydrogen and uses.

e. Reduction (in the narrow sense). Quantitative reduction of copper oxide.

VI. Atomic Theory.

a. Founded by Dalton. Developed from Law of Definite Proportions and Law of Multiple Proportions; but memorization of latter law not required.

b. Characteristics of atoms.

1. Indivisible in chemical action.
2. All atoms of a given element alike; of different elements, unlike.
3. Definite weight; atomic weights, oxygen standard. Use of abbreviations as symbols for atoms.

VII. Electrical constitution of atoms (see bibliography).

a. Matter composed only of electricity; the idea developed by brief reference to electrification on contact of dissimilar substances; cathode effect in Roentgen tube; radioactive decompositions.

b. Parts of the atom: nucleus composed of protons and electrons with protons in excess; rotating electrons.

c. Atomic numbers (for first twenty elements only) defined as the number of excess protons in the nucleus, this number being equal to the number of rotating electrons.

d. Distribution of rotating electrons in successive rings; helium, neon, argon, give clue as to number of electrons required for completing the successive rings 2, 8, 8.

e. Valence determined by the number of electrons in the outer ring; positive and negative valence; groups of elements as radicals with characteristic valence.

f. Chemical action explained as the borrowing and lending of electrons.

g. Elements classified as metal, non-metal, amphoteric, or inert by the number of electrons in the outer ring.

h. Chemical character determined almost wholly by rotating electrons; isotopes.

VIII. *Formulas and equations.*

a. Formulas written from knowledge of valence (unreliability of such determination unless confirmed by experimental analysis).

b. Variations in valence.

c. Equations; constant reference to experiment to found the idea that the possibliity of writing an equation does not justify the conclusion that the reaction can be made to occur. Equations for reactions already studied.

d. Weight—weight problems.

See Foot-note.

IX. *Metals—sodium, calcium and zinc.* (Purpose to found the idea of the chemical nature of metals.) Equations for all reactions.

a. Sodium: appearance; malleability; atomic number of sodium one electron in its outer ring; action with water (hydrogen collected); basic character of water solution.

b. Calcium: appearance; compared with sodium in malleability; atomic number of calcium; two rotating electrons in the outer ring; action with water, hydrogen collected; basic nature of the remaining solution.

c. Zinc: appearance; compared with sodium and calcium as to malleability; inactive with water; action with acids (hydrogen collected); zinc hydroxide prepared by precipitation.

d. Copper: appearance compared with sodium, calcium and zinc as to malleability; inactive with water; inactive with dilute acids; copper hydroxide prepared by precipitation.

e. General character of metals; appearance, malleability, good conductors of heat and electricity (relate this to the few electrons in the outer ring); metals as base forming elements.

f. Electromotive series of metals.

X. *Non-metals.* (Purpose to found the idea of the chemical nature of non-metals.) Equations for all reactions.

a. Oxygen reviewed; atomic number; six electrons in the outer ring; action with metals.

b. Chlorine: action with metals; with hydrogen; great activity; bleaching action involving a replacement of oxygen; atomic number; seven electrons in the outer ring; practical applications of chlorine in disinfecting and in bleaching; hydrogen compound as a typical acid; acids treated simply as chemical opposites of bases.

c. Sulfur: allotropic forms; action with metals; comparison with chlorine and with oxygen; hydrogen sulfide as a weak acid; sulfur dioxide; use in bleaching; water solution as an acid; sulfur trioxide and sulfuric acid mentioned.

d. General character of non-metals; appearance; non-conductors of heat and electricity; acid formers.

XI. *Solution.*

a. General nature of solutions; suspensions; colloids.

NOTE—In the topical list specific mention of preparation of elements and their compounds, and description of individual properties is omitted on the ground that the laboratory will continue to give experiments of the present type. The experiment and a discussion of the experiment should precede a text-book assignment on a topic.

b. Ionization.
  1. Electrolytes and non-electrolytes.
  2. Ions distinguished from atoms; use electron theory.
  3. Explain acids, bases, and salts in terms of ions; action on indicators.
  4. Activity of acids and bases determined by degree of ionization.

XII. Bases, Acids, Neutralization, Salts.
  a. Constitution of bases; metal joined to hydroxyl group: ionic conception.
  b. Strong and weak bases; sodium hydroxide, potassium hydroxide, calcium hydroxide, ammonium hydroxide; (preparation or manufacture not treated here.)
  c. Insoluble bases: zinc hydroxide; ferric hydroxide; comparative study of the properties of bases.
  d. Constitution of acids; hydrogen linked to non-metal or negative radical; ionic conception.
  e. Strong and weak acids: hydrochloric, sulfuric, nitric, acetic, carbonic; (preparation and properties not treated here.)
  f. Neutralization: the union of hydrogen and hydroxyl ions to form undissociated water.

XIII. Half-way elements: carbon, aluminum.
  a. Aluminum: atomic number, three electrons in the outer ring; usually a metal, but often acts as a non-metal; hydroxide amphoteric; uses: for kitchen utensils and as an electrical conductor.
  b. Carbon: allotropic forms; atomic number; four electrons in the outer ring—therefore both positive and negative; connection with fuels; use as a reducing agent.

XIV. Periodic classification.
  a. Zero valence; inert elements.
  b. Monovalent; alkali metals; importance of potassium in fertilizers; halogens; comparative activity alone stressed.
  c. Trivalent; nitrogen, phosphorus; relation of both to fertilizers.
  d. Tetravalent; carbon and silicon; relation of carbon to living matter; silicon to minerals.

XV. Heats of formation with reference to chemical stability; relation to three types of chemical reaction: direct combination, simple decomposition and replacement. Prediction of action or no action in simple cases.

XVI. Principles by which double decompositions go to an end; mass action; hydrolysis.

XVII. Industrial chemicals. Their manufacture and uses studied in light of chemical principles so far acquired; stressing mass action and catalysis.
  a. Hydrochloric acid.
  b. Sulfuric acid.
  c. Nitric acid from sodium nitrate and sulfuric acid.
  d. Ammonia and ammonium hydroxide.
  e. Sodium carbonate and sodium bicarbonate.
  f. Lime (including reference to limestone, cement, concrete, gypsum and plaster of paris).

XVIII. Electricity in chemistry; stress heats of formation; manufacture of soduim hydroxide, chlorine, oxygen, hydrogen, aluminum, calcium carbide, carborundum, nitric acid and nitrates from air, carbon disulfide.

XIX. *Mathematical problems.*
a. Avogadro's hypothesis.
1. Volume—volume.
2. Weight—volume; use of the gram molecular volume (22.41).

XX. *Carbon compounds.*
a. Oxides of carbon; elaborate as in New York State syllabus.
b. Crude petroleum and its products.
c. Products of the distillation of wood and soft coal; benzene.
d. Hydrocarbons and substitution products; (methane and ethane) (chloroform, carbon tetrachloride); hydrocarbon radicals.
e. Organic acids (formic and acetic).
f. Alcohols (methyl and ethyl; glycerine; structural similarity to bases).
g. Esters (ethyl acetate; fats; soap-making); structural similarity to salts.
h. Carbohydrates. Starch, cellulose, glucose, cane sugar.
i. Proteins (as constituents of foods).

XXI. *Metals.*
a. General principles of extraction from their ores.
1. Reduction of oxides, iron oxide reduced by carbon.
2. Roasting followed by reduction, zinc sulphide or zinc carbonate.
3. Electrolysis, aluminum oxide.
b. Refining of metals.
1. Wrought iron from pig iron.
2. Electrolytic refining of copper.

XXII. *Oxidation and Reduction in terms of electron theory.*
a. Oxidation defined as loss of electrons.
$(Fe^{++} \longrightarrow Fe^{+++})$
b. Reduction defined as gain of electron.
$(Fe^{+++} \longrightarrow Fe^{++})$
c. Oxidation always accompanied by reduction and vice-versa.
d. Ozone, hydrogen peroxide, manganese dioxide, nitric acid, hot concentrated sulfuric acid as oxidizing agents.
e. Hydrogen, carbon, carbon monoxide, hydrogen sulfide, sulfur dioxide as reducing agents.

XXIII. *Alloys*—sterling silver, coin silver, brass, bronzes (Cu-Sn, Al-Cu), carbon steels, special steels (chrome, nickel, tungsten, etc.)

XXIV. *Scientific research and the scientist's habits*—as suggested in the preface and supplementary matter of the New York State Syllabus.

Bibliography.

Owing to lack of space the list of books given in the New York State Syllabus is not repeated here. This accompanying list is given to supplement the State list:—

On the Electron Theory of the Atom—

H. A. Kramers and Helge Holst: The Atom and the Bohr Theory of Its Structure (Glydendal, London).
E. N. da C. Andrade: The Structure of the Atom (Harcourt, Brace & Co.)
F. W. Aston: Isotopes (Arnold, London).
Bertrand Russell: The A. B. C. of Atoms (Dutton).
Sir Oliver Lodge: Atoms and Rays (Doran).
Sir William Bragg: Concerning the Nature of Things (Harper).
Benjamin Harrow: The Romance of the Atom (Boni & Liveright).

Other Books.

F. Soddy: Science and Life (Dutton).
James Kendall: Smith's Inorganic Chemistry (Century).

J. H. Hildebrand: Principles of Chemistry (Macmillan).
E. E. F. D'Albe: The Life of Sir William Crookes (Appleton).
Sir William A. Tilden: Sir William Ramsay (Macmillan).
S. A. Arrhenius: Chemistry in Modern Life (Van Nostrand).
J. S. Chamberlain: Chemistry in Agriculture (Chemical Foundation).
H. E. Howe: Chemistry in Industry, 2 vols. (Chemical Foundation).

COMMITTEE ON CHEMISTRY.

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AUGUSTUS KLOCK, Ethical Culture School, New York.

Note. By vote of the Association, the Chemistry Committee is continued for another year. This action was taken so that criticisms and results of experimentation may be collected and presented at next year's meeting. All teachers of chemistry are urged to cooperate, to try out any of the ideas which appeal to them as worth while, to make suggestions that may lead to better outlines for secondary schools; and to criticise the Committee's efforts with this same end in view.

VIEWS RUBBER WITH X-RAYS.

The question whether raw rubber, apparently the most formless of substances, really has a crystalline structure appears to have been recently settled by actually seeing the crystal pattern produced on a luminous screen, according to Prof. George L. Clark, of the Massachusetts Institute of Technology. Dr. Clark, in a report to the American Chemical Society, gives the credit for this achievement to Dr. Ernst Hauser, of the Metallbank of Frankfurt, Germany.

"Dr. Hauser and an assistant imprisoned themselves in total darkness for five hours," said Dr. Clark, "in order to make their eyes sensitive enough to see the faint pattern of spots produced on a glowing screen of calcuim tungstate by X-rays which had passed through a sample of the rubber."

The effect, which is not the same as the familiar use of X-rays to reveal the bones of the body, flaws in metal, etc., was described by Dr. Clark as follows: "When a beam of X-rays pass through any material composed of crystals, such as salt or ice, a definite pattern is produced, and the design of the pattern depends on the arrangement of the atoms in the crystal. Noncrystalline substances, like glass, give no such patterns. Many materials and even rubber, have been studied in this way, and their patterns are more or less well known, but practically only from photographs. In the case of rubber it was especially important to see the pattern directly with the eye, in order to be sure that the crystal structure was not changed, or even, possibly, produced in the rubber by the action of the X-rays.

"Dr. Hauser and his helper not only subjected their own eyes to a long and tedious sensitizing process, but they used an X-ray tube of extraordinary power, which consumed 130 milliamperes of current at a potential of seventy thousand volts."

"When they turned on the X-rays after their long imprisonment," said Dr. Clark, "the hitherto unseen pattern flashed out instantly, faint but clear, against the pale greenish glow of the screen."—*Science Service.*

PROBLEM DEPARTMENT.

CONDUCTED BY C. N. MILLS,
Illinois State Normal University.

This department aims to provide problems of varying degrees of difficulty which will interest anyone engaged in the study of mathematics.

All readers are invited to propose problems and to solve problems here proposed. Drawings to illustrate the problems should be well done in India ink. Problems and solutions will be credited to their authors. Each solution, or proposed problem, sent to the Editor, should have the author's name introducing the problem or solution *as on the following pages.*

The Editor of the department desires to serve its readers by making it interesting and helpful to them. Address suggestions and problems to C. N. Mills, Illinois State Normal University, Normal, Ill.

CORRECTION.

December issue, page 1002, Problem 935. In the third line of the statement of the problem, the $\angle ABD$ should read $\angle ADB$. In the fourth line from the bottom of the page, the $\angle ADF$ should read $\angle ADB$.

SOLUTIONS OF PROBLEMS.

900. *Proposed by C. E. Githens, Wheeling, W. Va.*

A and B are at different points on a straight road. A travels toward B and reaches B's original position eleven minutes after B had left. B travels toward A and reaches A's original position fifteen minutes after A had left. Each then starts back, and they meet half-way at 4:00 P. M. When did they start?

Solved by Watson Dalton, Okmulgee, Okla.

It is obvious that if A starts first, B must be the faster runner; and if B starts first, A must be the faster runner, in order to meet half-way back at the same time.

(1). Assume that B starts first. Let x be the number of minutes B starts ahead of A; then

$$\frac{3}{2}(x+15) = \text{B's total time there and half-way back.}$$

$$\frac{3}{2}(11-x) = \text{A's total time there and half-way back.}$$

Hence $\frac{3}{2}(x+15) = \frac{3}{2}(11-x)+x$. Therefore $x = -3$ minutes, which shows that the assumption was wrong.

(2). Assume that A starts first. In this case we have

$\frac{3}{2}(15-x)+x = (11+x)$. Hence $x = 3$ minutes. Therefore A's total time is 21 minutes, and B's total time is 18 minutes. This means that A started at 3:39 P. M., and B started at 3:42 P. M.

941. *Proposed by J. S. Georges, University School, Chicago.*

The ceiling of a church is in the form of a surface consisting of two circular half cylinders with equal radii a, with lengths l and m respectively, intersecting each other at right angles, and with their elements intersecting the walls at right angles. It is required to find the total volume of the church if the distance from the floor to the highest point of the ceiling is k.

Solved by Raymond Huck, Shawneetown, Ill.

The intersection of the plane surfaces of the semi-cylinders form a square which is the projection of the common solid. The common volume is $\frac{8a^3}{3}$ The volume of the rectangular part of the church is $lm(k-a)$. Hence the total volume of the church is expressed by

$$lm(k-a)+\frac{\pi a^2}{2}(l+m)-\frac{8a^3}{3}$$

The volume $\frac{8a^3}{3}$ is found by $4\int_0^a (a^2-x^2)dx$.

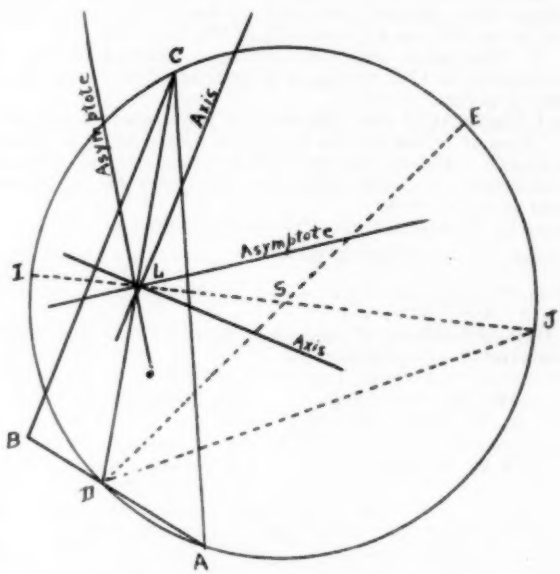
Also solved by the *Proposer*. Three incorrect solutions were received.

Editor. It is proposed in problem 960, in this issue, to find the common volume to the two intersecting cylinders by mensuration.

942. *Proposed by Virginia Seidensticker, Hyde Park, Chicago.*

Construct a triangle given the angle A, side a, and the bisector of the angle C.

Solved by Nathan Altshiller-Court, University of Oklahoma.



Let ABC be the required triangle, and D the trace of the internal bisector CD on the side AB. The $\angle A$ being given, if CD is kept fixed, the vertex A describes an arc of a circle (S), while the external bisector of the $\angle C$ remains fixed and joins C to the diametric opposite E of D on this circle. From the locus of A a locus for B may be obtained in the following manner.

For a given position of A the point B is determined as the intersection of DA with the harmonic conjugate of CA with respect to CE, CD. Thus we have

$$D(A \ldots\ldots) \bar{\wedge}\ C(A \ldots\ldots) \bar{\wedge}\ C(B \ldots\ldots) .$$

The first two of the three pencils are directly equal, while the last two are inversely equal, therefore the first and the third are inversely equal. Hence, *the locus of B is an equilateral hyperbola* (H) *on which the centers* C, D *of the two pencils are diametrically opposite points.*

The lines DA, CB will be parallel when A coincides with an end of the diameter IJ of (S) perpendicular to CD, hence the lines DI, DJ are the asymptotic directions of (H). Now CD being a diameter of (H), the

midpoint L of CD is the center of (H), and the parallels through L to the lines DI, DJ are the asymtotes of (H); we obtain the axes of the curve by drawing the bisectors of the angles formed by the asymtotes.

When $\angle A$ coinçides with D, the line DA coincides with the tangent to (S) and CB coincides with CD, hence (H) is tangent to (S) at D.

By making A coincide with E, it is seen that (H) passes through E; and by making A coincide with C we find that the tangent to (H) at C is the perpendicular dropped from C upon the diameter DE of (S). We have thus a locus for B. The second locus for B is the circle (B) having C for a center and the given length a, for a radius. Having found the point B, the line DB will meet the circle (S) in the third vertex A of the required triangle.

The circle (B) and the rectangular hyperbola (H) have, in general, four points in common, hence the problem may have four solutions. Two of these solutions are always real, no matter how small a may be, because the center C of the center C of the circle (B) lies on (H). However not all the solutions thus obtained will always be satisfactory, because the point A must lie on (S), on a given side of the line CD.

Remarks. I. The same solution applies if instead of the internal, the external bisector of C is given, or if instead of the $\angle A$, the circumradius of ABC is given.

II. In the triangle ACD the difference of the angles C and D is equal to the $\angle A$. Now if either of the triangles ABC, ACD is constructed, the other is known. Hence, the preceding considerations also solve the problem: *Construct a triangle given two sides, and the difference of the angles adjacent to one of them.*

943. *Proposed by Leonard Carlitz, Philadelphia, Pa.*

Find the value of the infinite product

$$\frac{2}{\sqrt{2}}\cdot\frac{2}{\sqrt{2+\sqrt{2}}}\cdot\frac{2}{\sqrt{2+\sqrt{2+\sqrt{2}}}}\cdot\ .\ .\ .\ \text{to infinity.}$$

Solved by Michael Goldberg, Washington, D. C.

The infinite product is equivalent to

$$\sec\frac{\pi}{4}\sec\frac{\pi}{8}\sec\frac{\pi}{16}\sec\frac{\pi}{32}\ .\ .\ .\ .\ .\ \text{ad infinitum.}$$

$$\sin 2a = 2\sin a\cos a = 4\cos a\cos\frac{a}{2}\sin\frac{a}{2}$$

$$= 2^{n+1}\cos a\cos\frac{a}{2}\cos\frac{a}{4}\cos\frac{a}{8}\ .\ .\ .\ .\ \cos\frac{a}{2^n}\sin\frac{a}{2^n}.$$

$$\cos a\cos\frac{a}{2}\cos\frac{a}{4}\cos\frac{a}{8}\ .\ .\ .\ \cos\frac{a}{2^n} = \frac{\sin 2a}{2.2^n\sin\frac{a}{2^n}}.$$

Letting n increase without limit

$$\cos a\cos\frac{a}{2}\cos\frac{a}{4}\ .\ .\ .\ \text{ad}\ \infty = \frac{\sin 2a}{2}\lim_{r\to\infty}\frac{1}{r\sin\frac{a}{r}} = \frac{\sin 2a}{2a}.$$

$$\text{When } a = \frac{\pi}{4},\ \cos\frac{\pi}{4}\cos\frac{\pi}{8}\cos\frac{\pi}{16}\cos\ .\ .\ .\ \text{ad}\ \infty = \frac{2}{\pi}.$$

$$\text{Therefore, }\sec\frac{\pi}{4}\sec\frac{\pi}{8}\sec\frac{\pi}{16}\sec\frac{\pi}{32}\ .\ .\ .\ \text{ad}\ \infty = \frac{\pi}{2}.$$

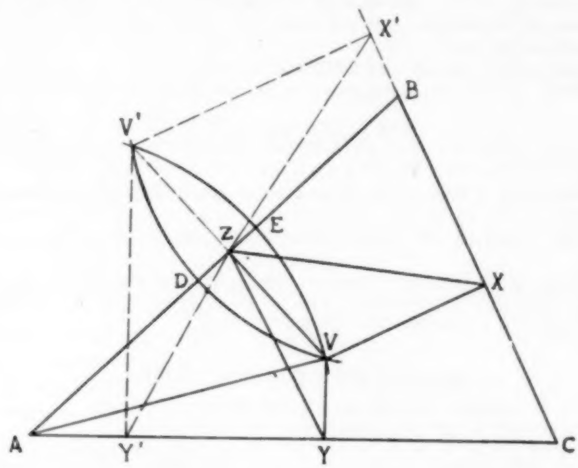
Note that the successive products are the successive one-fourth perimeters of a polygon of 2^n sides inscribed in a circle of unit radius, and hence approach one-fourth the circumference of the circle as a limit.

Also solved by the *Proposer*. Two incorrect solutions were received.

944. *Proposed by George Sergent, Tampico, Mexico.*

From a point V within a triangle ABC, perpendiculars VX, VY, VZ, are drawn to the sides a, b, c, respectively. Determine V so that XZ equals a given length, m, and YZ a given length, n.

Solved by Michael Goldberg, Washington, D. C.



On the line AB locate D whose distance from line BC equals m, and E whose distance from line AC is n. With B as center, draw an arc through D; with A as center, draw an arc through E. The intersection of these arcs is the required point V.

Proof I. Let $AZ = d$, $AY = e$, $AE = r$, $\angle EAV = K$. Then $(YZ)^2 = d^2+e^2-2de\cos A = r^2[\sin^2K+\sin^2(A\text{-}K)-2\sin K\sin(A\text{-}K)\cos A] = r^2\sin^2A = n^2$.
Hence $YZ = n$. Similarly $XZ = m$.

Proof II. *Orville F. Barcus, Columbus, Ohio.*

The quadrilateral, BXVZ, one of whose diagonals is the given line m, is inscriptible in a circle whose diameter BV is constant. $\angle XVZ$, supplement of $\angle B$, is a constant and subtends chord m which is a constant. Likewise, the given line n is a chord of constant length, and AV is the diameter of the circle in which the other quadrilateral, AYVZ, may be inscribed.

The solution is an application of Problem 923, the solution of which appeared in the October, 1926, issue.

Also solved by *Nathan Altshiller-Court, University of Okla.; J. F. Howard, San Antonio, Texas; J. Murray Barbour, Aurora, N. Y.;* and by the *Proposer.*

945. *For High School Pupils. Proposed by J. F. Howard, San Antonio, Texas.*

The lines joining the vertices of a triangle to the points of contact of the inscribed circle are concurrent.

Editor. No solutions were received for this problem. Two solutions are submitted, one of which is not beyond the High School pupil.

I. *Analytical Solution.* Let a be the radius of the inscribed circle having its center at the origin of coordinates. Let K, L, and M be the three points of tangency, having the coordinates $(d. e)$, (b, c), and $(0,-a)$. The vertices of the triangle A, B, C, have the following coordinates;

$$\left\{\frac{a^2+ac}{b}, -a\right\}, \left\{\frac{a^2(e-c)}{be-cd}, \frac{a^2(b-d)}{be-cd}\right\}, \left\{\frac{a^2+ae}{d}, -a\right\}.$$

The equations of the lines AK, CL, and BM are as follows.

AK: $(ab+be)x-(bd-a^2-ac)y-a(bd+ae+ce) = 0.$

CL: $(dc+ad)x-(bd-a^2-ae)y-a(bd+ce+ac) = 0.$

BM: $(ab-ad+be-cd)x-a(e-c)y-a^2(e-c) = 0$

The vanishing of the determinant formed from the coefficients of the three preceding equations, proves that the three lines AK, CL, and BM are concurrent.

II. *Applying the converse of Ceva's Theorem.*

If points K, L, M *are taken on the sides* BC, AB, CA *of a triangle, such that*

$$\frac{AM \cdot CK \cdot BL}{CM \cdot AL \cdot BK} = -1,$$

then are AK, BM, CL *concurrent, the sense of the lines being taken into account.*

Since AM = AL, CM = CK, BK = BL (metrically), the problem is solved.

The following theorem is also proven by use of the same theorem.

The lines joining the vertices to the points of contact of the corresponding ex-circles with the opposite sides are concurrent.

PROBLEMS FOR SOLUTION.

Wanted. Some good problems for the Algebra section.

956. *Proposed by Victor A. Ivanhoff, Pittsburgh, Pa.*

On a round billiard table two balls have a given position. Find the point X, by geometric construction, on the circumference of the table, where the first ball must strike in order to hit the second ball.

957. *Proposed by I. N. Warner, Platteville, Wis.*

I desire to find the specific gravity of a piece of wood that will not sink in water. Given a piece of copper which weighs 36 ounces in air and 31 1/2 ounces in water. The wood weighs 70 ounces in air. The piece of wood and the copper, when tied together, will sink in water and weigh 11.7 ounces. Find the specific gravity of the wood.

958. *Proposed by A. J. Patterson, Wheeling, W. Va.*

The center of one circle lies on the circumference of a smaller circle. The crescent of the larger circle is equal to the total area of the smaller circle. Show that the angle K formed by the radii of the larger circle, drawn to the ends of the common chord, is such that, $K = 2\pi + \tan K$. Find $\angle K$ in degrees.

959. *Proposed by I. N. Warner, Platteville, Wis.*

Two men were walking along a railway track, each at the rate of 3 miles per hour, and in opposite direction. A passing train ran completely by one of them in 5 seconds and by the other in 6 seconds. How many feet long was the train?

960. *For High School Pupils. Proposed by the Editor.*

Two circular cylinders, of radius a, intersect each other at right angles, the axis of one intersecting the axis of the other. Show that the volume common to the cylinders is $\frac{16a^3}{3}$. This problem can be worked without the use of the calculus.

Public desire to learn the English language has caused the establishment of classes in English in the Gimnasio Paraguayo, the "public forum of Asuncion." English classes have been inaugurated generally in the schools and colleges of Paraguay.—George Kreeck, American Minister, Asuncion.

A REPLY—AVAILABLE SCIENCE TESTS, STEPHEN G. RICH.

By J. L. Cooprider,
Evansville, Ind.

There are a number of discrepancies or misunderstandings in the article under the above title which was published in the November number of School Science and Mathematics, Vol. 26, pp. 845-852. It seems that before such an article is published, the writer should have made a study of each and all of the tests he reports, as well as articles written by the authors of these tests. This is quite a task, I admit, but in order to do justice to the tests, their authors, and the users of tests, I believe this should be done.

The writer of the above article states that the reliability for the *Dvorak General Science Tests* is "over .55." I find no mention of this in the manual, neither do I find an article written by the author stating this fact, however this might be an oversight on my part. The norms given in the manual cover 1,700 cases with a range of 70 items, which seem to be fairly adequate for working purposes.

The authors of the *Ruch-Cossman Biology Test* state in their manual that their norms are tentative, only 500 cases being reported at the end of the second semester. The mean reliability of Form A with Form B is shown in the manual to be .82 for 92 cases.

The writer states that the reliability is not known for the Cooprider Biology Tests (Exact title—*Information Exercises in Biology*). If this writer will read one of the best **Journals for all Science and Mathematics Teachers,** School Science and Mathematics, Vol. 25, No. 8, November, 1925, on page 811 he will find this—

"The coefficient of reliability according to *Brown's* formula is **.92,**" which was worked out as stated there with **169** cases. There are **577** cases reported in the manual and **1,026** cases reported in the article referred to above. The author states in both of these accounts that *the norms* are tentative.

The writer states that the *Information Exercises in Biology* are "similar to—(and that the)—content is substantially the same as the Ruch-Cossman test." I wish to state that Cooprider knew nothing of the content of the Ruch-Cossman test when his test was sent to the Public School Publishing Company. Cooprider is in possession of a letter from Mr. Geo. A. Brown, President of the above company, dated, Sept. 10, 1923, in which Mr. Brown states the following:

"We thank you for your letter and enclosures of Sept. 8. We do not now have a test for high school biology . . . we shall have yours examined by our editor, Dr. B. L. Buckingham, Director Bureau of Research, Ohio State University . . . we inclose our order blank and contract."

In a letter from Mr. Brown dated Nov. 5, 1924, occurred the following:

"We have been keeping our printers busy with a variety of printing, and the publication of your tests has been delayed, but we expect to put your tests in the hands of the printer in a short time."

The test was published early in 1925, after it had been shelf-worn for several months, but I beg to inform the readers that it was not copied, as was inferred by the writer.

The writer of the article states that the reliability is not known for the *Michigan Botany Tests.* If he will look at the bottom of the "fairly adequate" manual for this test he will find this paragraph:

"**Note.** The coefficient of reliability as indicated by correlating the score on the even questions with those on the odd questions in .87 ± .02. The coefficients of correlation between the scores on the 4 tests and the term grades given averages .53, with a range of from .29 to .75."

The writer does not seem to make clear what he means by an "adequate manual." He states that the manual for the Michigan Botany Tests is "fairly adequate" yet this has one 6x9 inch sheet. He states that the

Manual for the *Information Exercises in Biology* is "rather incomplete," and this has the same number of pages, with more instructions for giving and scoring the test. He declares those manuals "usually complete" or "amply complete," which have 8 pages or more. It seems to me that we do not need to burden the publishing company with an 8-page, 8x11 inch manual, when one 6x9 inch sheet will do the work. Again, it seems to me, that the authors of tests need not burden an already-burdened-down-teacher with mastery of many details of constructing the test and other items irrelevant to giving and scoring the test to be given. I think you will find, Mr. Rich, that those of us who are designated as "high school science teachers" and who use the modern tests have been fairly well trained in the giving, scoring and use of tests and other modern methods. As a rule, I think you will find that where long manuals are provided, the users will not and do not have the time to master the various items, hence the directions are not followed, and the procedure of giving and scoring the test is not kept constant. The thing needed, perhaps is a uniform method of giving and scoring all tests.

You state that the manual should be complete. I do not find in the manual of 8 pages, 8x11 inches, accompanying your chemistry test where you state that the reliability for this test is "over .60" as you state in your present article. Neither do I find your manual as simple to understand as you indicate that they should be. It is of the type which should be in the hands of makers of tests or the testing expert, but for the teacher in the field, a much simpler manual and one which is uniform with present practices would be to the point.

I do not wish to defend other tests, nor my own, by this reply. As for my test, and I believe that other authors will say the same thing about their tests, I know that we have developed very poor tools for the measurement of science instruction. We seem to be mainly concerned with the informational side of the test, but what are we doing with such things as judgment, attitude, and understanding of the scientific method. Until we have developed better measuring devices, I believe that we should make the best use of those we have at the present.

SUN'S ACTIVE RAYS INCREASE.

The ultra-violet rays of the sun, the part of sunlight that causes sunburn and cures some diseases, are stronger as the spots on the sun grow more numerous, and there are indications that when the eleven-year maximum of spots is reached within the next year or so, the sun will give off about two and a half times as much ultra-violet light as it did in 1923, when the spots were least numerous. This is the conclusion of Dr. Edison Pettit, of the Mt. Wilson Observatory, who is conducting a study of this invisible but important part of sunshine.

Dr. Pettit's method depends on the fact that the ultra-violet radiation passes through a thin layer of silver, but not of gold, while a similar layer of gold transmits visible green light. As glass is opaque to the ultra-villet, two lenses of quartz are used, one of which is silvered, and the other gilded. These lenses can form an image of the sun on a vacuum thermocouple, which gives an electric current when light falls on it. This current is measured with a galvanometer, and from it can be determined the intensity of the ultra-violet or the green radiation, depending on whether the silvered or gilded lens is used. As the intensity of the green light remains relatively constant, it is used as a standard with which to compare the ultra-violet.—*Science Service.*

CENTRAL ASSOCIATIONS OF SCIENCE AND MATHEMATICS TEACHERS ANNUAL MEETING, FRIDAY, NOV. 26, 1926.

It is so easy to accept good things that sometimes we do not recognize our obligations for them. Neither do we pause long enough in the rush of modern life, to appreciate fully the significance of our experiences. It has been aptly said that we are in such a hurry nowadays, that we are greatly disconcerted by the delay occasioned by missing one section of a revolving door.

I hope, however, that in spite of our haste and many responsibilities, we shall not let each of these annual meetings pass by without recognizing the careful preparations made for them by the president, all other officers, all committees, student assistants, and speakers on the general and sectional programs. We are fortunate, indeed, to have men and women each year so untiring in their efforts to present to us worthwhile and stimulating programs. The pleasure and inspiration which come from meeting old friends and making new ones, in addition to the valuable programs, more than compensate for the time spent in attendance at these annual meetings.

Three innovations in the meeting this year are worthy of comment:

1. This year for the first time special railroad rates were assured members.

2. Non members were charged admission, fifty cents for general meetings, twenty-five cents for section meetings. The amount realized this year was $19.75.

3. Registration cards were filled out in each section. The results were as follows: Mathematics 55, General Science 34, Biology 48, Physics 62, Chemistry 39, and Geography 18. Total of 256. Some members spent part of the time in one section and the rest in another. Each was registered, however, only once.

At the Friday morning session, the 300 members and others present had the pleasure of listening to the band of the Crane Junior College, followed by the address of welcome by W. J. Bartolf, principal of the school. A response in behalf of the Association was made by the vice president, Prof. E. R. Breslich, The University of Chicago, the School of Education. A preliminary report of the Committee on Resolutions was read by the secretary. This report in full will appear elsewhere in the records of the Association.

A pause in the program was made in which the members of the Association paid their respects to the first president, Charles H. Smith, whose untimely death in May is a source of sincere regret to all in any way connected with this Association. Mr. Charles Turton, the life long friend and business associate of Mr. Smith, gave a brief but sympathetic and understanding report of the life and work of Mr. Smith. Following this report, the members of the Association as an expression of their respect and appreciation rose and with bowed heads paid honor to him who was the first president of the Association, and who for the first time since its organization was not present.

I believe that I am expressing the sentiment of many of the Association, when I say that I have felt that there is something missing in the meeting this year and that I realize that it is Mr. Smith's cheery: "Hello, how are things going?" together with his big, generous, sympathetic but vigorous personality. If life is measured in service and influence, not in years, then Mr. Smith's was a long and useful one.

Excellent and stimulating addresses were given in the morning by Dr. George F. Kay, Dean of College of Liberal Arts, State University of Iowa, on "The Place of Man in the Universe" and by President Max Mason of the University of Chicago on "Science and the Technique of Living." We were fortunate, indeed, to have two such outstanding educators address us. A conducted tour through the school, a visit to the exhibits, and an excellent luncheon concluded the morning program.

The afternoon section meetings were well attended. Minutes of the

meetings and many of the papers given will be published in School Science and Mathematics. A reception was held following the afternoon program.

The 98 who attended the dinner at the Y. M. C. A. Hotel had a happy social time, an excellent dinner, followed by the presentation in an able manner of the much discussed problem of evolution: "What Shall Be the Attitude of the High School Teacher Toward the Theory of Evolution," by Professor H. H. Newman of the University of Chicago. An interesting discussion followed the address led by Mr. Jerome Isenbarger, followed by other members, and closed by Dean Kay.

The Association, as previously stated, is indebted to many for the success of the meeting. Special recognition should be given to the president, Mr. F. E. Goodell, and to the chairman of local arrangements, Mr. W. C. Hawthorne. The Association is also indebted to the Crane Junior College for the use of the building and the many courtesies extended in other ways.

Saturday Morning, November 27.

The annual business meeting was called to order at nine o'clock by the president. His report was concerned principally with finance connected with advertising. The total receipts for advertisements this year, he reported, will total $726.00. His report was accepted as read and ordered placed on file.

The Minutes of the Annual Meeting of the Association were read by the secretary and accepted as read.

The report of the treasurer, Mr. W. G. Gingery, indicated that the financial condition of the Association is satisfactory. In fact, it compares favorably with that of last year. The total expenditures for the year were $2,450.48, the total receipts, $3,062.56, leaving a balance on hand of $612.08. The report was accepted and placed on file.

Mr. Frank B. Wade reported that the Auditing Committee, of which he was chairman, approved of the treasurer's books and that all accounts were correct. The Association accepted Mr. Wade's report as given.

The Necrology Committee of which Mr. Charles M. Turton was chairman reported the deaths of five members: Charles H. Smith, Chicago; Dana W. Hall, Chicago; Philip Greeley, Fort Wayne, Indiana; Prof. G. M. Armstrong, Ohio Wesleyan University, Delaware, Ohio; and Mr. Allan Peterson, Des Moines, Iowa. The report of this committee was accepted, placed on file, and it will be published in full in the "Journal of School Science and Mathematics."

Much of the success of the membership committee depends upon its chairman, Mr. W. F. Roecker, Boys' Technical High School, Milwaukee, Wisconsin. His report indicated, as it did last year, the expenditure of much time and effort to maintain the present members and to add new ones. The Association is greatly indebted to Mr. Roecker and his committee for their work. His report was approved.

In the absence of Col. Harry D. Abels, chairman, the report of the Nominating Committee was given by Mr. W. G. Gingery. The nominations were reported as follows: President, E. R. Breslich, The School of Education, The University of Chicago, Chicago, Illinois; Vice-president, W. F. Roecker, Boys' Technical High School, Milwaukee, Wisconsin; Secretary, Winnafred Shepard, Proviso Township High School, Maywood, Illinois; Corresponding Secretary, Margery Stewart, New Trier High School, Kenilworth, Illinois; Treasurer, W. G. Gingery, Shortridge High School, Indianapolis, Indiana, was elected last year for a period of two years; Assistant treasurer, Ersie Martin, Arsenal Technical High School, Indianapolis, Indiana. The report was approved and the Secretary instructed to cast a unanimous ballot for all nominees.

Dr. Elliot R. Downing, chairman of the Committee on Resolutions, gave the next report. He first reported a request from the American Association for Medical Progress that this Association endorse the effort being made to initiate legislation necessary to provide for material relief needed by Mr. Kissinger and to a degree also by the widows of Dr. Carroll,

Dr. Reed, and Dr. Lazear, and also to vindicate our national honor through suitable public expression of appreciation of the heroic services rendered in connection with the Yellow Fever Investigation in 1900. This Association expressed its willingness to endorse this movement. The secretary is notifying the American Association for Medical Progress to that effect.

Dr. Downing again presented the "Resolutions" which had been read at the Friday morning session requesting "that a committee be appointed by the president to formulate a plan of action with powers to proceed as far as possible under the direction of the executive council toward the establishment of a National Council of Science Teachers." It being understood by the committee that such a Council when formed is not to interfere with the present organization of Science and Mathematics Teachers.

The salient points in the discussion which followed the presentation of this report follow. Mr. Stone, representing the mathematics teachers, wanted to know if it was the intention of the present Association to become a part of the National Council of Science thereby dropping off the mathematics teachers. Dr. Downing in reply pointed out the fact that the Mathematics teachers had formed a National Council and yet had not dropped off the Science teachers in the Central Association. He further indicated that the present organization would continue as it now is. He also stated that the only official relation which exists between this organization and the Journal of School Science and Mathematics is that it pays $2.00 to the Journal for each member who in turn receive the Journal. Mr. Smith gave his approval to the formation of a National Council of Science Teachers. Miss Gugle spoke of the fact that most mathematics teachers feel that they can not take two magazines, and consequently they prefer to take the "Mathematics Teacher" which is all devoted to mathematics. She favors the resolution to form a National Council of Science with the present Journal to become its organ and be given over entirely to science, while the present members of the Central Association who are mathematics teachers be given the privilege to subscribe for the "Mathematics Teacher," rather to receive it with their membership in the Association. Mr. Holtzman expressed his approval of what Miss Gugle had said.

The discussion was continued by Mr. Wade who said the small school should not be overlooked, where teachers were teaching more than one subject. Mr. Warner was asked for an expression as to the number of teachers teaching several subjects. He said he had no data to report, but felt that there were many who wanted the Journal to continue in its present form. However, he personally is willing to do whatever seems to be for the best interests of education.

The president then called attention to the fact that the question before the house was whether the recommendations of the Committee on Resolutions to the end that steps be taken toward the formation of a National Council of Science be accepted. A motion was made and approved that the report be accepted. A further motion was then made and accepted that the president appoint a committee to report at the next annual meeting on plans relative to the formation of a National Council of Science Teachers. It being understood that all matters relative to such a step be considered and investigated.

Mr. Frank B. Wade presented the following recommendation which was accepted, and a copy of which is being sent to Mr. W. J. Bartolf. "Be it resolved that the Central Association of Science and Mathematics Teachers wishes to express to Principal W. J. Bartolf and through him to his teachers and to the boys of Crane Technical High School and Junior College, who have served us in various ways during their holiday time, our sincere appreciation of the splendid facilities and many courtesies extended to us.

We are especially indebted to the boys' band for the splendid music furnished at the opening of our meeting. To Mr. W. C. Hawthorne of Crane Junior College we express our thanks and acknowledgements for

his efficient management of local affairs during our meeting." The Business Meeting was then adjourned.

At ten o'clock the All Science Section meeting was called to order. The hundred members presented listened with great interest and profit to the following excellent program: "The Evolution of Modern Geography," Prof. R. H. Whitbeck, University of Wisconsin; "Industry's Estimate of the Value of Training in the Sciences to its New Recruits," Mr. A. H. Carver, Industrial Relations Department, Swift and Co.; "Transmission of Pictures over Telephone Wires," Mr. O. T. Schrage, Division Supervisor of Instruction and Employment, American Telephone and Telegraph Company.

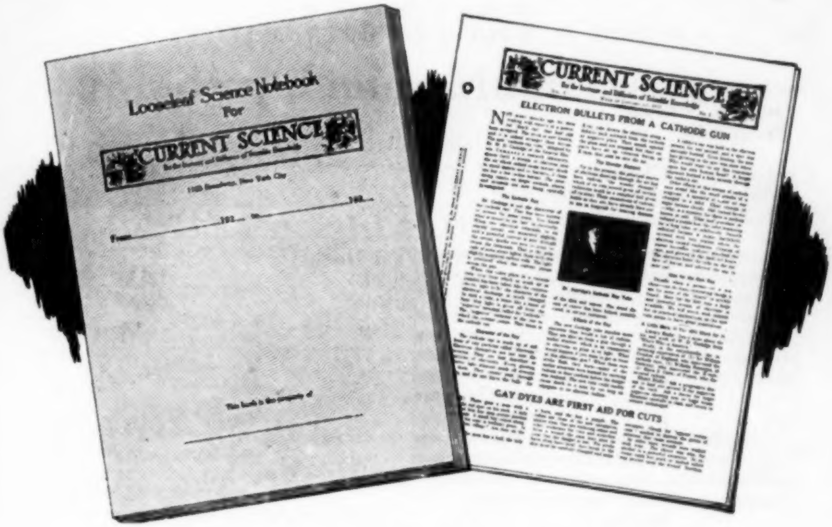
The meeting was adjourned at twelve-thirty.

ADA L. WECKEL,
Secretary.

TREASURER'S REPORT.

NOV. 18, 1925, THROUGH NOV. 15, 1926.

RECEIPTS:			
From Memberships (Serial Numbers 1109-1836 inc.)			
682 Regular memberships at $2.50			$1,705.00
1 Membership only			.50
36 Irregular memberships (those paying Mr. Turton, for whom he pays the Treasurer) at $.50			18.00
9 Members who paid Ira Davis (who paid the treasurer 50c each, balance to Mr. Turton) at $.50			4.50
728 Total paid memberships. Total receipts			$1,728.00
Paid Mr. Turton for 682 regular memberships			$1,364.00
Net receipts from memberships			364.00
For exchange (included with checks from members)			.45
For advertising in Year Book			686.00
Note: This is not all of the advertising in the 1925 Year Book, as $84.00 was collected Nov. 13, 1925, and included in the 1925 report.			
To replace bad check (name omitted)			2.50
Cash on hand, Nov. 18, 1925			645.61
Total Receipts			$3,062.56
PAYMENTS:			
To Mr. Turton for 682 regular memberships			$1,364.00
To Mr. Turton for 7 honorary memberships			14.00
Printing:			
Year Book, Kable Brothers		$ 519.19	
Statements, S. H. S. Echo Press		7.75	
Stationery, The Regal Press		53.50	
			580.44
President's expense		$ 24.87	
Secretary's expense		10.02	
Treasurer's expense:			
Bond	$ 2.50		
Ledger Cards	20.25		
Clerical work	50.00		
Postage	34.00		
		106.75	
Membership Committee:			
F. E. Goodell	$ 4.45		
W. F. Roecker	56.69		
		61.14	
Local Committee		24.49	
Badges		44.35	271.53
Speaker, Redpath Lyceum Bureau			60.00


Looseleaf Science Notebook
For
CURRENT SCIENCE
CURRENT SCIENCE
ELECTRON BULLETS FROM A CATHODE GUN
GAY DYES ARE FIRST AID FOR CUTS

Sections:		
General Science	$ 10.79	
Geography	33.36	
		44.15
University of Chicago:		
Lantern room and operator	$ 30.42	
Check room rental	9.75	
		40.17
Kable Brothers (postage on returned Year Books)		1.52
Irvington State Bank (to replace bad check)		2.50
Traveling expenses of Executive Committee:		
F. E. Goodell	$ 40.95	
R. H. Struble	25.62	
W. F. Roecker	5.60	
		72.17
Total payments		$2,450.48
Cash on hand, Nov. 15, 1926		612.08
		$3,062.56

W. G. Gingery, *Treasurer.*

REPORT OF THE NECROLOGY COMMITTEE.

During the past year, five members have died.

Charles H. Smith, Hyde Park High School, Chicago, Ill.

Dana W. Hall, Ginn and Company, Chicago, Ill.

Philip Greeley, Fort Wayne, Ind.

Prof. G. M. Armstrong, Ohio Wesleyan University, Delaware, Ohio.

Allan Peterson, East High School, Des Moines, Iowa.

CHARLES H. SMITH (1861-1926) was born at Mexico, New York, and educated at Cornell University, graduating in 1885. He entered the profession of teaching and came to the Hyde Park High School, Chicago, in 1890 as teacher of Physics. For the past 18 years he has been the Assistant Principal. In 1901, with a few others, he organized the Central Association of Physics Teachers, which the next year became the Central Association of Science and Mathematics Teachers. He was the first president and never missed a meeting, which distinction is shared by only one other member. In 1904, together with Charles M. Turton, Mr. Smith undertook the publication of School Science and of School Mathematics. These two publications were then consolidated into School Science and Mathematics. He was a charter member of the Illinois State Academy of Science. Actively interested all his life in boys and boys' work, he was one of the founders and a director of the Hyde Park Y. M. C. A. A strong personality, aggressive, hating and fighting sham in all its forms, a Christian gentleman of the highest type, a member of the Hyde Park Methodist Church, and active in all good works.

DANA W. HALL was a member of this Association for the past six years. He always had been very much interested in the work of the Association and attended the meetings when ever they were held in Chicago.

PROF. G. M. ARMSTRONG was a member for the past eight years joining in 1918. He was a professor of Mathematics and always had a great admiration for our Journal and was a thorough believer in the work of the Association.

MICHAEL PHILIP GREELEY joined the Association in 1923. He was a member of the Mathematics section. He was an able teacher and was probably the best liked teacher in Fort Wayne.

ALLAN PETERSON was one of the best liked teachers in Des Moines. He joined the Association in 1913. He was a very active member of the Physics section. He was one of the founders of the Central Iowa Science Teachers' Association. He was an outstanding man, greatly beloved by all who knew him.

Charles M. Turton,
Chairman.

REPORT OF THE COMMITTEE ON RESOLUTIONS.

The Committee on Resolutions confines its report to one matter which seems of such large importance that it is worthwhile concentrating all of our discussion upon it. We recommend that the Association take steps to insure the formation of a national association of Science teachers. Similar associations have already been formed by teachers of English, Mathematics, Latin, Geography, etc. and the work of these national associations has been so important that they appear to demonstrate the value of such national organizations.

It seems to the committee that in all probability if such a national association could be launched, it would be possible to obtain from someone of the educational foundations enough support in a financial way, in addition to the funds that the association itself could raise, to put in a field secretary as was done in Mathematics, English and Latin to organize the work of the national association on a permanent basis. The committee feels that unless some such arrangement can be made, the task of organization would be too great for anyone to undertake in addition to customary duties.

The committee would recommend the appointment of a small committee to formulate a plan of action with powers to proceed as far as possble under the direction of the executive council. In making these recommendations, the committee feels assured that such a national association would not interfere with the work of the Central Association of Science and Mathematics Teachers, but would rather strengthen it. The Central Association would be one of the groups of teachers that would enter the national association. It might be one of the functions of the national association to stimulate the formation of associations similar to the Central Association in other parts of the country.

Respectfully submitted,

Elliot R. Downing, *Chairman*,
Frank E. Goodell,
Ada L. Weckel.

MINUTES OF MEETING OF BIOLOGY SECTION.

The Biology section of the 1926 meeting of the Central Association of Science and Mathematics Teachers was held in Room 401 of the Crane Junior College on Friday, November 26 at 1:30 p. m.

The meeting was called to order by the chairman, Charles M. MacConnell of Evanston, Ill., who then appointed a nominating committee with Mr. L. E. Hildebrand of the New Trier Township High School as chairman; Mr. Fred Werner, Milwaukee, Wis.; and Miss Mabel E. Smallwood, Lane Technical, Chicago, Ill.

The first paper was read by Clarence L. Holtzman, vice principal of Waller High School, Chicago, whose subject was "Queer Plants and Animals That Men Eat." Mr. Holtzman exhibited and served to an appreciative audience many of the food stuffs that he described.

Dr. Franklin D. Barker, Professor of Zoology at Northwestern University, discussed "Ways and Means for Vitalizing the Biological Sciences." His paper provoked a number of questions and many helpful suggestions were brought out in the discussion.

A stimulating paper on "The Relation of Laboratory Work to High School Biology" was read by Dr. M. M. Wells, President of the General Biological Supply House of Chicago.. Dr. Wells lamented, as had Dr. Barker, the teaching of biological subjects by teachers who do not know their materials so that their teaching becomes text book work.

An illustrated lecture on "Glacier National Park, a Naturalist's Outdoor Laboratory" was given by Dr. Warren G. Waterman, Associate Professor of Botany at Northwestern University. Dr. Waterman presented views of the principal valleys and divides of the park and showed many unusual slides in describing the trees and flowers of the reservation.

At the close of Dr. Waterman's talk the chairman voiced the feeling of the meeting in thanking the speakers.

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The nominating committee named for chairman Wallace Worthley of the Francis Parker High School, Chicago; vice-chairman Miss Ruth Allerdice, Shortridge High School, Indianapolis; for secretary Miss Aline Cullison, Crane High School, Chicago.

The report of the committee was adopted and the meeting adjourned.

Upon the refusal of Wallace Worthley to act as chairman the nominating committee selected James R. Locke, Highland Park High School, Detroit, to serve as chairman of the 1927 meeting.

RUTH ALLERDICE,
Secretary.

MINUTES OF THE MEETING OF THE GEOGRAPHY SECTION.

The meeting of the Geography Section of the Central Association of Science and Mathematics Teachers was held at the Crane Junior College on the afternoon of November 26. The meeting was called to order by the Chairman, Mr. James H. Smith of the Austin High School, Chicago. He extended a cordial greeting to the nineteen geographers present, remarking that the gathering was distinguished for the quality of those present if not for the quantity. The chairman then appointed the following nominating committee who were instructed to bring in recommendations by the close of the meeting: Chairman, Mr. W. E. Headley, Austin High School, Chicago; Miss Edna Crown, Peoria, Ill.; Mr. James Baird, Harrison Technical High School, Chicago.

The first topic was "Some Definite Ways to Use Illustrative Material in the Teaching of Geography" presented by Mr. William P. Holt, Bowling Green, Ohio. Mr. Holt explained and illustrated the use of pictures as a method of aiding the student in forming more accurate concepts of the nature and development of the relief features of the earth's surface. Mr. Holt had some very clever, original devices for combining thought-provoking questions with the pictures which could be easily prepared and used by any teacher. The subject was very interestingly presented and was rich in practical, helpful suggestions.

A lively discussion followed during which the value of various types of illustrative material for the teaching of geography were discussed. The use of the stereoscope and the value of accumulating a museum were especially stressed.

The next topic on the program was a "Presentation of Contour Mapping" by Mrs. Viva Dutton Martin, Arsenal Technical Schools, Indianapolis, Indiana. Mrs. Martin spoke of the need of a more widespread understanding of contour maps because of the constantly increasing number of people who are traveling in automobiles. She then briefly traced the steps in the presentation of contour mapping to a class. An exhibit of the work of students done in the manner outlined further illustrated the plan of teaching. While the members of the meeting inspected the exhibit the nominating committee withdrew for a brief meeting.

Mr. Thomas H. Finley of the Austin High School, Chicago, read a paper on "The Kind and Amount of Geography that should be Included in the High School Curriculum." Mr. Finley outlined very definitely the type of material which should appear in a high school curriculum and also gave very excellent reasons for his selections. He stressed the need of a reasonable knowledge of the geography of the world because of the constantly increasing foreign relations of the United States. The increase in all methods of communication are bringing the parts of the world so close together that a geographical knowledge of them is essential to an intelligent understanding of the present progress of human events.

Dr. Ray Hughes Whitbeck of the University of Wisconsin, Madison, Wisconsin, spoke on "Geography in the Education of American Youth." He expressed his approval of the course as proposed by Mr. Finley and enlarged upon the present need of a wisely chosen geography course in the education of American youth. Dr. Whitbeck is a speaker of rare charm and the Geography Section was much honored and its program greatly enriched by his remarks.

A lively general discussion followed the close of Dr. Whitbeck's talk. In the course of this discussion a request was made that Miss Katharine Ulrich of the Oak Park High School should tell how she had succeeded in building up the geography department and making it so popular in that school. Miss Ulrich presented the plan she had so successfully used in a very interesting manner.

The meeting was characterized throughout by a very lively interest on the part of every one present.

The nominating committee reported the following names for officers for the next year:

Chairman—Mrs. Viva Dutton Martin, Arsenal Technical Schools, Indianapolis, Indiana.

Vice Chairman—Mr. Lynn Halverson, Joliet Township High School, Joliet, Illinois.

Secretary—Mr. Thomas H. Finley, Austin High School, Chicago.

By consent of the meeting the Chairman instructed the secretary to cast a white ballot for the persons reported by the nominating committee.

VIVA DUTTON MARTIN,
Secretary.

MINUTES OF THE MATHEMATICS SECTION, CENTRAL ASSOCIATION.

The Mathematics Section of the Central Association of Science and Mathematics Teachers met Friday afternoon, November 26, 1926.

The meeting was called to order by the chairman, Mr. Everett W. Owen of Oak Park and River Forest Township High School. Mr. Owen appointed as nominating committee: Mr. Allison, Mr. Comstock, and Miss Newlan.

The first speaker on the program was Prof. R. D. Carmichael of the University of Illinois, who gave a very helpful and interesting talk on "The Writing and Choosing of Mathematical Text Books." Dr. Carmichael first discussed the contribution of various high school subjects to the development of the student; he said that, while geometry is one of the subjects contributing the most, that algebra is not contributing as it is capable of doing because it is becoming too much of a mechanical process, and that if mechanical drill work is made the end and aim we are sounding the death knell of the subject. It was the opinion of the speaker that too much of terseness has gotten back into our mathematical text books; that the text book should be addressed to the student, and not to the teacher or to the subject matter. The most important question to consider in choosing a text book is whether it is clear to the student.

The discussion which followed was led by Miss Newlan of Oak Park. She said that a score card with relative ratings given to different topics was absolutely necessary. She then told how they were prepared and used in Oak Park School.

"Impressions from my Study of Mathematics" was next presented in a very interesting manner by George Mahin, Oak Park High School, '27, F. N. Whaley, Northwestern University, '29, and Chaloner McNair, Yale, '26, of Oak Park, Illinois. These young men discussed very frankly the things they liked and disliked about the study of mathematics in a manner that was both interesting and suggestive.

Mr. C. M. Austen of Oak Park and River Forest Township High School next outlined the work of the National council of Mathematics Teachers since its organization and urged greater support on the part of mathematics teachers. Mr. Austen introduced the question of the separation of the science and mathematics sections of the Central Association, and in case that seems advisable recommended that the Mathematics Section of the Central Association form a central section of the National Council with "The Mathematics Teacher" as their official paper. After considerable discussion, a motion was made and seconded that those who had spoken on the subject constitute a committee to choose a committee of three to meet and consider the matter. The motion was carried. Among

those taking part in this discussion were Miss Gugle, Mr. Austen, Mr. Allison, Mr. Stone, Mr. Comstock, Mr. Coultrap, and Mr. Owen.

"Evaluating Materials Adjusted to Varying Abilities When Used with a Group of Unclassified Pupils" was, owing to the lateness of the hour, very breifly discussed by Dr. Schorling. Dr. Schorling said that the older type of mathematics seems not to have obtained desired results and that the new courses, because they place so much emphasis on interest, may also fail unless attention is given to the psychology of drill. He stressed particularly the need of much practice for a few skills, rather than a little drill on each of many things, and also the necessity of a drill exercise being specific.

The report of the nominating committee was read by Mr. Allison. It was as follows: For chairman, Mr. Joseph A. Nyberg of Hyde Park High School; for vice-chairman, Mr. Edwin W. Schreiber of Proviso Township High School, Maywood, Illinois; for secretary, Miss Margaret Dady of Waukegan Township High School, Waukegan, Illinois. The report was accepted and these officers elected. The meeting adjourned.

A. Blanche Clark,
Secretary.

MINUTES OF THE PHYSICS SECTION.

The meeting of the Physics Section of the Central Association of Science and Mathematics Teachers was held in Room 166 of Crane Junior College, Friday, November 26 at 1:30 p. m. The chairman of the section, R. Howard Struble, of the Eastern High School, Detroit, presided.

The first paper on "The Unit Method of Instruction as Applied to Physics" was presented by R. S. Howard, Lyons Township High School, La Grange, Ill. Having used the unit method for a number of years Mr. Howard could speak from a practical viewpoint and his address was a very satisfactory exposition of this method of teaching. The following is a brief summary: The unit method of instruction has as its aim the changing of the learning attitude of the pupil. The subject matter becomes the agency to produce this change. This does not mean that the subject matter is slighted, but rather that it is given more consideration so that the subject becomes capable of producing a fundamental change in the pupil. Each unit must have a central theme which is fundamental and around this nucleus the pupil should be able to collect a mass of information that will give him a real understanding of the basic conception embodied in the unit. When the pupil has completely mastered the unit and has a proper understanding of the central theme his whole attitude toward his environment is changed, the world about him takes on a new significance, his interests are stimulated and another advance in his mental and social development has been realized.

The number of units into which the year's work in Physics is divided depends on the teacher. But the development of each unit usually follows the sequence of exploration, presentation, assimilation, organization and recitation. In the exploration period both the teacher and the pupil discover what the pupil already knows or does not know. The teacher then presents a birdseye view of the unit. This is followed by the assimilation period in which the pupil is required to master the central theme by extensive reading, laboratory work, conferences, etc. Then follows a written outline by the pupil in which the subject matter is organized around the nucleus of the unit. In the recitation which follows not more than six pupils participate, each one having been assigned some particular phase of the unit. The examination given to all the pupils will determine whether or not the fundamental adaptations have been made.

"The Metric System and Social Economy" was discussed by S. L. Redman of the Central Scientific Company, Chicago. He presented both the favorable and unfavorable considerations involved in the immediate adoption of the metric system in this country. In the foreign

trade there would be no great gain, he said, unless Great Britain would also adopt the system. Manufacturing plants could easily make the change if it were not for the investments in tools dies, parts and specifications in the form of tracings and blueprints. The greatest problems for the engineers would be the literature which has accumulated for centuries. The United States and local governments would encounter the greatest difficulties in the vast records accumulated, such as the Weather Bureau, the Coast and Geodetic Surveys, the Mining and Geological Surveys, the agricultural records, the township and county maps and survey records, titles to property, etc.

Mr. Redman emphasized that while a sudden and compulsory adoption of the Metric System has its objectionable features it does not necessarily follow that the change cannot ultimately be made. He pointed out that the Metric System is already being used by the electrical engineers, the U. S. Pharmacopoeia, the radio industry and that standardizing bodies, such as the American Society for Testing Materials, are beginning to give the Metric equivalents in parentheses where English units are used. Definite progress is in evidence. He felt that the idea of a gradual evolution toward the coveted goal had much in its favor.

During the general discussion the Physics Section voted to send the following resolution to the American Society for Testing Materials, Philadelphia; American Railway Engineering Association, Chicago; American Engineering Standards Committee, New York; Society of Automotive Engineers, New York:

"The Physics Section of the Central Association of Science and Mathematics Teachers respectfully urges that your organization, when recommending standardizations and specifications, designate the Metric equivalents of the English Units, in so far as it is practical to do so."

The next subject was "Simplifying the Teaching of Electricity by the use of the Electron Theory." This was very ably discussed by Glen W. Warner of the Englewood High School, Chicago. The following is a brief summary: The electron theory not only simplifies the teaching of electricity by making the electron the principal factor in all electrical phenomena but the fact that pupils are eager for information about the structure of the atom makes this theory the only logical approach to the subject. It is easy for pupils to understand that since a neutral atom contains the same number of protons and electrons, an excess of electrons will give a body a negative change and that when electrons are lacking the body has a positive charge. Herein lies the explanation for a difference of potential produced by friction, chemical action or the movement of a conductor in a magnetic field. In each case electrons have been accumulated or crowded together. These electrons repel each other so that some of them tend to escape by means of a conductor. In a conductor the atoms have only a few electrons in the outer ring. In a non-conductor the outer ring of the electrons is nearly complete. Metals therefore are conductors. Non-metals are non-conductors. The simplest way to explain the cathode ray, the X-ray, the vacuum tube, wireless telegraphy and the radio are by means of the electron theory. A mental picture which includes the structure of the atom and the movement of electrons is fascinating for the average high school pupil.

A very interesting discussion developed in connection with a general question box conducted by H. C. Krenerick, North Division High School, Milwaukee, Wis. Mr. Krenerick will make a report of this part of the program in a later number of SCHOOL SCIENCE AND MATHEMATICS.

The following officers were elected for the ensuing year: President, M. J. W. Phillips, West Allis, Wis.; Vice President, J. M. Kurtz, Bowen H. S., Chicago; Secretary, E. S. Obourn, John Burroughs H. S., St. Louis, Mo. The nominating committee consisted of G. B. Eisenhard, Culver Military Academy, Culver, Ind.; A. W. Augar, Tilden H. S., Chicago, and E. E. Burns, Austin H. S., Chicago.

J. M. KURTZ,
Secretary.

ARTICLES IN CURRENT PERIODICALS.

American Mathematical Monthly, November, Menasha, Wis., $5.00 a year, 60 cents a copy. The Origin of the Term "Algebra," Solomon Gandz, Rabbi Isaac Elchanan Theological Seminary, New York City. On the Correlation Between Two Functions, F. M. Weida, Lehigh University. Concerning the Probability Curves of N Points Taken at Random on a Straight Line Segment of Constant Length, W. B. Chadwick, Wilmington, Delaware. Early Literary Evidence of the Use of the Zero in India, Bibhutibuhusan Datta, University College of Science and Technology, Calcutta. Numerical Integration of Ordinary Differential Equations, W. E. Milne, University of Oregon.

Education, December, The Palmer Co., Boston, $4.00 a year, 40 cents a copy. Educational Reform in State Universities, Paul A. Herbert, Duluth, Minnesota. A Remedy for Retardation in the High School, G. David Houston, Principal of the Armstrong Technical High School, Washington, D. C. The Life-Career Motive in Secondary Education, J. F. Santee, Oregon Normal School, Monmouth. Education? Why? O. Herschel Folger, Wilmington, Ohio. Thought-Power and Hurdles, Russell Paine, San Diego, California.

Journal of Chemical Education, December, Rochester, N. Y., $2.00 a year, 35 cents a copy. The Centenary of Cannizzaro, Lyman C. Newell, Boston University, Massachusetts. The Cathode-Ray Tube—A New Chemical Agent, Guy Bartlett, General Electric Co., Schenectady, N. Y. Some Historical Aspects of Chemistry, R. E. Davis, Lane Technical High School, Chicago, Illinois. From Atom to Life, William Foster, Princeton University, New Jersey. Classification and Segregation in Analytical Chemistry, Carl J. Engelder, University of Pittsburgh, Pa. Predicting Performance in Chemistry. II. Jacob Cornog and George D. Stoddard, University of Iowa, Iowa City. The Vitamins, H. C. Sherman, Columbia University, New York City.

Journal of Geography, December, 2249 Calumet Ave., Chicago, $2.50 a year, 35 cents a single copy. Reading Purposes in Geography, P. W. Hutson, University of Pittsburgh. Red Rock Canyon, California, William J. Miller, University of California, Los Angeles. Some Principles of Commercial Geography, G. T. Renner, Columbia University.

Journal of the National Education Association, January, Washington, D. C. School Lands and the States, George H. Dern, Governor of Utah. Character and School Studies, Herbert Martin, Drake University, Des Moines, Iowa. Featuring the Humble Textbook, Charles Lowe Swift, Pottstown, Pa.

The Mathematical Gazette, G. Bell & Sons, London, July. Comparison between Rhumb-Line and Great-Circle Courses, Prof. P. J. Heawood. Some Points on the Teaching of Rational Mechanics, Prof. L. N. G. Filon. A Problem in Fourfold Geometry, D. B. Mair. October. Mathematical Logic, F. P. Ramsey. The Stieltjes Integral in Harmonic Analysis, J. C. Burkill. Note on the Teaching of Analytical Geometries.

The National Geographic Magazine, December, Washington, D. C., $3.50 a year, 50 cents a copy. Skirting the Shores of Sunrise, Melville Chater. Among the Shepherds of Bethlehem, John D. Whiting. Exploring the Earth's Stratosphere, Lieut. John A. Macready.

Photo-Era Magazine, December, Wolfeboro, N. Hampshire, $2.50 a year, 25 cents a copy. What Makes a Picture Artistic? Warwick Barse Miller. Protographing Bird and Animal-Tracks in the Snow, Dan McCowan.

Popular Astronomy, December, Northfield, Minn., $4.00 a year, 45 cents a copy. William Joseph Hussey, Ralph H. Curtiss. The Great Fireball of August 2, 1924, Charles P. Olivier. Lunar Appulse, 1926, December 18-19, William F. Rigge.

Science, December 17, Grand Central Terminal, New York City, $6.00 a year, 15 cents a copy. The Functions of a Woman's Clinic, J. Whitridge Williams, The John Hopkins Hospital. Tertiary Man in Asia—The Chou Kou Tien Discovery, Dr. Davidson Black, Peking Union Medical

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College, China. December 24, Medicine and the Evolution of Society, Professor John C. Merriam, Carnegie Institution of Washington. Research and the Universities, John H. Penniman.

Scientific American, December, New York, $4.00 a year, 35 cents a copy. The Multiple Eyes of Insects, H. Eltringham. Eclipsing Variables, Henry Norris Russell, Ph. D. Princeton University. Luminous Bacteria, the Smallest Lamps in the World, E. Newton Harvey, Ph. D., Princeton University. New 6,000,000 Cubic-foot Airships for Our Navy, C. P. Burgess.

Scientific Monthly, December, The Scientific Press, New York, $5.00 a year, 50 cents a copy. Some Interesting Animal Communities of Northern Utah, Professor W. C. Allee, University of Chicago. The Riddle of Life, Professor J. E. Greaves, Agricultural College, Logan, Utah. Genius and Health Dr. J. F. Rogers, U. S. Bureau of Education. A Trip to Santo Domingo, Professor Frank D. Kern, Pennsylvania State College. A Mountain Solar Observatory, Dr. C. G. Abbot, Smithsonian Institution. The Metric System of Weights and Measures, Professor A. E. Kennelly, Harvard University.

The School Review, December, University of Chicago Press, $2.50 a year, 30 cents a copy. Survey of Extra-Curriculum Activities in the High School, Gertrude Jones, Lincoln High School, Lincoln, Nebraska. Our Best Teachers, C. O. Davis, University of Michigan. The Junior College as Viewed by its Students, J. Fletcher Wellemeyer, Central High School and Junior College, Kansas City, Kansas. A Method of Increasing Interest and of Providing for Individual Differences in the High-School Science Laboratory, Harland M. Bright and G. L. Bush, John Adams High School, Cleveland, Ohio.

BOOK REVIEWS.

Second Course in Algebra for Secondary Schools, by Alan Johnson, Head of Mathematics Department, Barringer High School, Newark, N. J., and Arthur W. Belcher, Head of Mathematics Department, East Side Commercial and Manual Training High School, Newark, N. J. pages iv+322. 13.5x19 cm. 1926. New York. F. M. Ambrose Co.

Teachers desiring a conservative type of algebra will find this book worthy of their consideration. It is designed for tenth, eleventh, or twelfth year work to prepare students for college and state examinations as well as for future work in mathematics.

There are numerous examples. A great deal of attention is given to making, interpreting, and using formulas. There are four place tables of squares and square roots, logarithms, natural and logarithmic trigonometric ratios. Review excercises and tests are placed where they are needed. J. M. Kinney.

Arithmetic Work-Books for Grades Three to Eight by F. B. Knight, G. M. Ruch, and J. W. Studebaker. Edited by G. W. Myers. pp. 74. Pupils' Edition, $0.36; Teachers' Edition, $0.48. Chicago, Scott, Foresman and Company.

These unusually well written work-books, one for each grade, should be in the hands of every teacher of arithmetic. It seems to the reviewer that every child would be delighted with his study of arithmetic if it were presented to him in the manner set forth in these books. Some of the features to be noted follow.

1. The work units of each book enable the teacher to supplement her textbook with one standardized drill a week.

2. Each work unit consists of two facing pages. The left-hand page contains: (1) Study notes inwhich arithmetic topics are retaught by different approaches from those of the usual textbook. (2) Extra practice which gives the pupil a chance to improve his work by himself. The right hand page contains: (1) A drill on examples and problems involving previously taught fundamental skills, presented in mixed order. (2) Standards for self-rating.

3. A progress chart, printed on the last page, enables the pupil to chart his own record throughout the year. J. M. Kinney.

Columbia Research Bureau Plane Geometry Test, by Herbert E. Hawkes, Professor of Mathematics and Dean of Columbia College, and Ben D. Wood, Associate Professor and Director Bureau of Collegiate Educational Research Columbia College, Columbia University, World Book Co., Yonkers-on-Hudson, N. Y., and 2126 Prairie Ave., Chicago.

This test is designed to afford high schools and colleges more reliable and more comparable measures of achievement in plane geometry than are afforded by the customary examinations. It is based on the elements common to most of the texts which are used in the United States. The principal examination contains two kinds of questions:

Part I. True-False. This part consists of 65 "true and false" statements concerning such things as the meaning of terms, propositions, corollaries, loci, problems, constructions, and formulas.

Part II. Problems. This part is made up of 35 problems ranging from very easy to very difficult.

The scoring of both parts of the test is entirely objective. Part I may be scored by clerks. Part II requires some knowledge of mathematics on the part of the scorer. The test requires about sixty minutes to administer and can be scored in about one fourth of the time required by the old type of examination. It affords results which are two or three times as reliable as those of the traditional subjective examinations.

J. M. Kinney.

Elementary Accounting, Part II, by Hiram T. Scovill, Professor and Head of Department of Accountancy and Henry H. Baily, Assistant Professor of Accountancy, University of Illinois. Pages x + 457. 15x22 cm. 1926. D. C. Heath and Co.

This book is a continuation of the subject of accounting as presented in Part I by the same authors. Part I covered the field of bookkeeping in its simple aspects, the preparation of financial statements and went, in its final chapters, into the more strictly accounting problem of the adjustment of accounts.

Book II continues the subject through such chapters as Columnar Books, Controlling Accounts, Miscellaneous Books and Records, Business Papers, Cash Control, the Voucher System, Corporation Accounting, Consignments, Branch House Accounting, Single Entry, etc.

Each subject presented is carefully worked out, however, in a rather elementary way. The problem work is sufficient in amount and there is evidence of care in correlating it with the text material.

The principal objection to the text is the extent of space given to the subject of "Business Papers," the cataloguding and description of which make up more than two-fifths of the text. While it is conceded that a knowledge of business forms is important, should we not insist: (a) that it is elementary and should be presented in Book I; (b) that it be worked in incidentally to the bookkeeping training rather than treating it as a subject in itself?

The difficulty of presenting the subject would be avoided and a new interest on the part of the student would be found to appear if the suggestion in (b) above were worked out. On the whole the unity of subject matter and also the sequence would be improved were Chapters I and II of Book II, i. e., Columnar Books and Controlling Accounts transferred to Book I and Chapter XVI and Chapter XVII, viz., Deferred, Accrued, and Estimated Items, and Partnerships Accounts were made a part of Book II.

The authors of the text have experienced the same problem that other authors have unsuccessfully met, i. e., the problem of finding a logical sequence. Almost every "Book II" or advanced accounting text is an unrelated presentation of miscellaneous subjects. In some texts it is an inexcusable jumble.

Some author, some day will, it is confidently believed, hit upon the right plan and the result will be a systematic treatise, entirely logical, presenting in an easy and natural way the whole subject of accounting from its most elementary to its most advanced aspects.

Until that much desired day arrives Elementary Accounting (Scovill and Baily) Books I and II will probably serve adequately to guide our efforts.

C. C. Hand.

College Entrance and Regents Questions and Answers in Biology. College Entrance Book Company, Inc., 104 Fifth Ave., New York. Pp. 159. 12.5x18.5 cm. Paper covers. Price 50 cents.

The purpose of the book as given is to cover the subject matter in Biology as outlined in the latest syllabus of the New York State Department of Education and the College Entrance Examination Board. The questions are so arranged as to present a natural arrangement of each topic. The questions were taken from the Regents and other standardized examination papers. Simple drawings in outline form, where used, are clearly labeled to illustrate the subject matter. There are questions on general biology, on animal life, on plant life and on human physiology, and each question is answered definitely in non-technical language in a way that an elementary student might be expected to answer it. Such a book should prove valuable for anyone desiring to review the general principles and some of the details of elementary biology, and teachers in high schools will find these questions an aid in standardizing the work of their biology courses. Jerome Isenbarger.

General Botany, by C. Stuart Gager, Director of the Brooklyn Botanic Garden. Pp. xvi + 1056. 14.5x21 cm. 1926. P. Blakiston's Son & Co., 1012 Walnut St., Philadelphia. Price $4.00.

This new text of Gager's is a book of more than ordinary interest. Its organization is tied up with the personal interest and economic idea. Biological principles are illustrated by the use of the common and well-known plants. In words of the introduction, "Some who study this book may become interested in plants for their own sake, and become botanists; others will find botany only an added interest in life, while still others will, or have already, become interested in the applications of botany to horticulture or agriculture and other occupations of applied sciences founded in whole or in part on the science of botany. It is primarily for the latter class that this book is prepared." He chose the clover plant to illustrate the general problems of botany in Part I which is termed the Introduction and which takes up twenty-six pages.

Part II, The Vegetative Functions of Plants, is based mainly on the physiological processes, with just enough of morphology to make clear the discussion of processes. Two hundred and sixty-eight pages are used in this treatment.

Part III, Reproduction and Life Histories, gives a thorough discussion of the various phases, theoretical, and practical, of the subject of reproduction in plants, together with chapters on Lower Cryptograms, Character and Life History of Fungi, and Economic Importance of Fungi. Chapter XVI gives an excellent treatment on How Seeds Are Made. Chapter XVII discusses Cross-Pollination, including practical uses in plant growing, Part III includes material covering two hundred and fifty-three pages.

Part IV, three hundred and seventy-three pages, deals with The Great Groups of Seed-bearing Plants. This part of the text is particularly noteworthy as a valuable feature of this new type of botany text. It is cyclopedic in its treatment, giving interesting features and facts of the various groups, many of which are not found in the usual type of botany text.

Part V, seventy-seven pages, takes up the various phases of Genetics and Evolution. The concluding chapter, on Evolution, is valuable, giving as it does, the modern viewpoint of this increasingly difficult subject. With regard to Evolution and Religion, we find, "When the scientific man says he has explained something he means only that he has described it accurately and minutely; he understands it better only in the sense that he knows it more thoroughly. There still remains the great mystery of cause of all things. With this, natural science has nothing to do; that is the province of philosophy."

This is a college text which will serve a useful purpose as a text, but as a book of reference, it should be in every high school library and in the hands of every teacher or secondary school botany.

Jerome Isenbarger.